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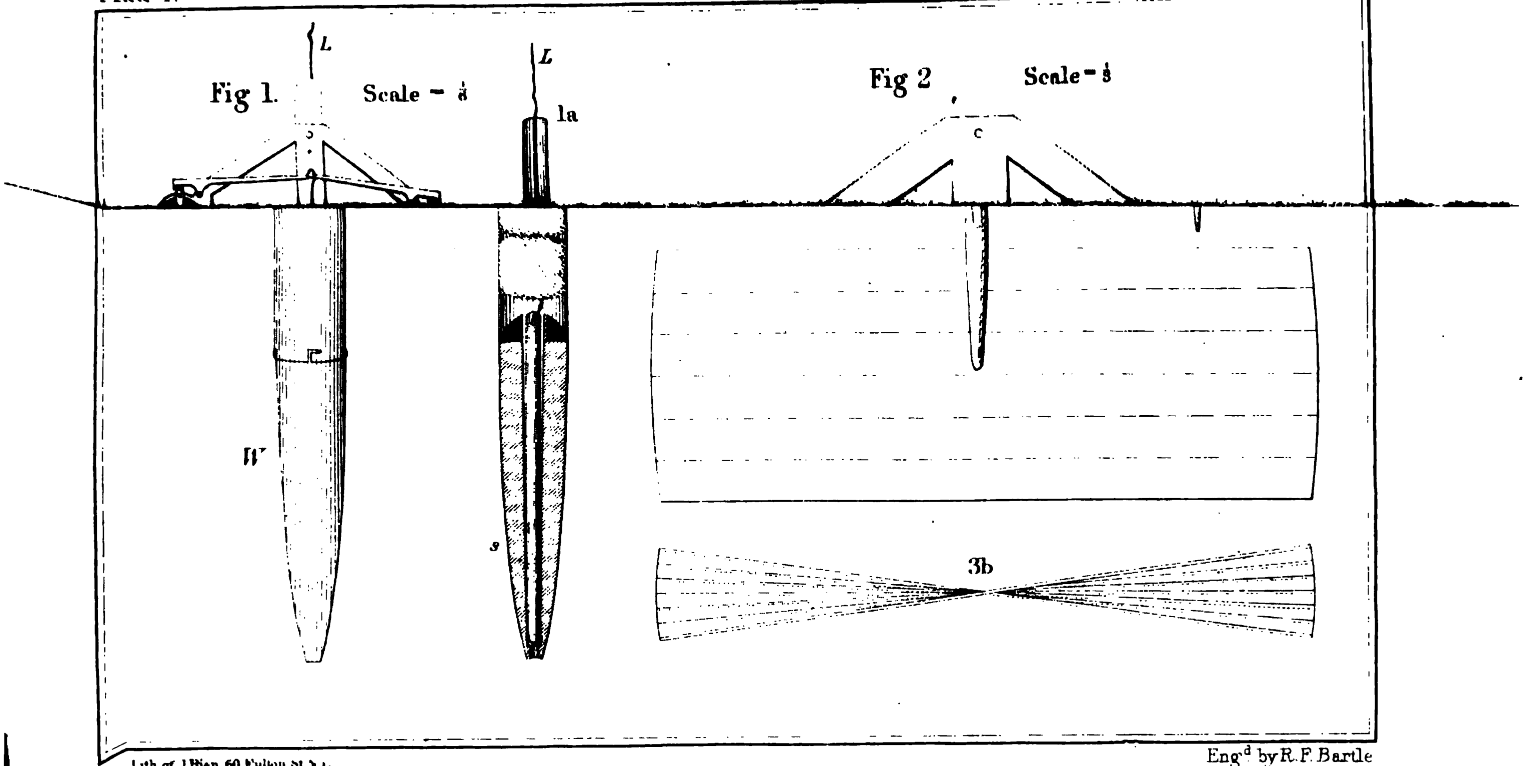
ERRATA.

Page 236, line 1, for "lightly," read "slightly."
" 236, " 7, insert "*side is a,*" between "other and branch."
" 240, insert specific name, "grandis," after "Actinocrinus."
" 240, line 15, for "obscure," read "obscurely."
" 241, " 2 from bottom, for "oval," read "oral."
" 244, " 14, for "armbones," read "umbones."
" 244, " 9 from bottom, for "cyclostomus," read "Cyclostomus."
" 248, " 25, for "p. c." read "oz."
" 249, " 37, for "G. J." read "J. P."
" 252, " 27, for "$\frac{1}{8}$," read "$\frac{1}{8}$."
" 353, " 14 from bottom, for "3·8924+121·80," read "3·8924×121·80."
" 253, " 10 from bottom, for "4·6440+121·80," read "4·6440×121·80."
" 291, bottom, for "Englemann," read "Engelmann."
" 408, (in some copies) 8 lines from bottom, for "Andreas," read "Andrae."

Plate 1.

IMPROVED DEEP SEA SOUNDING APPARATUS



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Eng^d by R. F. Bartle

THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

ART. I.—*On a new Sounding Apparatus for Deep-sea Sounding;* by Prof. W. P. TROWBRIDGE, Assistant U. S. Coast Survey.—With a Plate.

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Communication addressed to Prof. A. D. BACHE, Supt. U. S. Coast Survey, dated U. S. Coast Survey Office, Washington, D. C., April 6, 1859.

Dear Sir,—In my report to you of May 31, 1858, I had the honor of presenting the results of an investigation of the laws of descent of heavy bodies in the ocean, under the conditions required in deep-sea sounding.

The object of that investigation was to ascertain and develop fully the causes of failure and error in deep-soundings, and to devise a more certain and reliable mode of measuring the depth of the ocean, in the off-shore hydrography of the Coast Survey, and especially in the swift current of the Gulf Stream.

I have now to present for your further consideration a sounding apparatus based upon the developments given in my former report, and the result of further study and experiments on the subject.

The distinguishing feature of the method herein described, though exceedingly simple in its application, has never before been proposed, inasmuch as its necessity could hardly have been felt, without a careful analysis of the circumstances of descent of the sounding lead and line.

In the method of sounding heretofore employed, the influence of the friction of the water upon the line, or "endwise resist-

ance" as it is called by Prof. Airy, was known to exist, but the amount of this endwise resistance in pounds, and its ultimate effects at great depths, had not been determined. It was supposed that by making use of a weight of thirty or forty pounds and a small fishing line, this resistance would be reduced to an inappreciable amount, or at least that its effect in retarding the descent of the lead would not be sufficient to destroy confidence in the results.

It appears, however, from the investigations referred to, that a weight, such as is ordinarily used in sounding, will be practically held in suspension at no very great depth, even when the line used is the smallest that will sustain the weight with safety in the air; and in confirmation of this conclusion, the fact is well established, that, notwithstanding repeated experiments made by the most skillful officers and with the utmost care, the bottom of the ocean has never been reached in its deepest parts; and even where the bottom has been attained and specimens brought to the surface, the uncertainties of the results have given good grounds for controversy with regard to the depth.

These failures and uncertainties do not arise from the magnitude of the distance to be measured, nor from the impenetrability of the fluid through which the lead has to pass: distances infinitely great and infinitely small in the universe above and around us, have been measured with precision; and the unexplored depths of the ocean are occupied by a medium freely and equally penetrable at all depths. Yet in this field, a field daily traversed by the commerce of the world, a distance of a few miles only has baffled all attempts to measure it.

The difficulty lies in the simple cause stated above, viz. the "endwise resistance" or friction upon the sounding line, which prevents the lead from going to the bottom where the depth is great.

The apparatus which I have devised, is designed to avoid this friction upon the line, while at the same time the line is not dispensed with, but is made use of, as in the ordinary mode.

Before describing this apparatus I will briefly refer to some of the results given in my previous report on this subject.

The rate of descent of an iron globe or sphere, as the simplest geometrical form, was first determined when falling freely in the ocean, and it was found that a sphere will attain a certain maximum velocity, within twenty-five feet of the surface, which velocity will be kept up without sensible increase or diminution to the bottom.

For a 32 lb. iron shot this uniform velocity is about sixteen feet per second.

The conditions of descent when a small line is attached to the sphere and drawn down with it, were then discussed, the line

being uncoiled from a reel on the deck of the vessel, and drawn down by the weight of the sphere. The friction of this line in the water causes a remarkable change in the rate of descent. Nearly the same maximum velocity at starting is attained, but the velocity becomes rapidly reduced, until the sphere becomes suspended nearly motionless in the water.

Taking the simple case of a 32 lb. shot attached to a small fishing line, the shot attains its maximum velocity of sixteen feet per second within twenty-five feet of the surface, but before a hundred fathoms of the line is drawn into the water, this velocity is reduced to eight feet per second—a diminution of half the velocity from the friction of one hundred fathoms of line. At five hundred fathoms the velocity is again reduced half, or to four feet per second; and at three thousand fathoms to about one foot per second. *Whereas at this depth, if there is no line attached, the shot will fall with its original velocity of sixteen feet per second undiminished.* Below this depth we may determine, in the same way, the circumstances in the two cases: the shot falling freely still retains its uniform velocity of sixteen feet per second at four, five, and six thousand fathoms depth, while with the line attached, at five thousand fathoms the velocity is reduced to a few inches per second, and at six thousand fathoms the descent is not perceptible under ordinary circumstances.

The time of descent becomes an important element also in practice; in the two cases given, the shot falling freely will descend to the depth of three thousand fathoms in twenty minutes, and to the depth of six thousand fathoms in forty minutes. While with the line attached, it will require two hours to descend three thousand fathoms, and eight hours to descend six thousand fathoms. These effects were shown to be due to the friction alone; the amount of which in pounds, was determined for different cases, in which different forms of weight and different sizes of lines were used; and the entire inapplicability of the ordinary mode of sounding for great depths, and even for ordinary depths, where the object is to obtain a correct knowledge of the depths, was demonstrated.

Methods have been proposed in which a line is dispensed with, by detaching a float at the bottom, when the plummet strikes, and watching for the return of the float to the surface; but this is impracticable, as there is no material applicable, within our knowledge, that will float to the surface from the bottom of the sea, on account of the great pressure, which condenses the bulk, so us to render bodies specifically lighter than water at the surface, heavier than water at even moderate depths.

A line must therefore be used to bring back to the surface any machine by which the depth may be registered in the descent.

And the motion of this line in an extended form in the water must be avoided.

The apparatus which I have devised is designed to secure this object,—by attaching to the sinker a tube or case in which the sounding line is compactly coiled, and from which it will be discharged freely, thus causing the plummet to carry down the *coil*, while one end of the line is held fast at the surface; the line being uncoiled from the descending sinker in the manner that a spider falling from a height gives out a thread in his descent by which he retains communication with the point above to which the thread is attached. The motion of the line in an extended form through the water being thus avoided, all the conditions of free descent are secured, and the plummet will descend to the greatest depths with a rapid and uniform velocity.

The depth is ascertained in the manner heretofore known as Massey's method, by a helix or curved blade, which is caused to revolve, by the motion of the apparatus through the water. Instead of Massey's indicator however, which from its faulty construction does not give accurate results, I have adapted Saxton's Current Metre, a much more delicate instrument, to this purpose.

A specimen tube is also used differing somewhat from those now in use, in construction but not in its essential points.

The lower end of the line is attached to the register and to the specimen-box which weigh together only two or three pounds, and as the line is hauled in from the bottom it brings up the register and specimen-box, leaving the plummet and attached case at the bottom.

The details of construction are shown in the accompanying drawings and description of the apparatus.

Besides overcoming the principal difficulty in sounding, there are other important advantages secured by this arrangement which simplify rather than complicate, the problem. These are as follows:

First, there is no strain upon the line, in the descent, except from its own weight, no matter to what depth or with what velocity, the plummet may descend.

It is possible therefore to employ a very small line; a single thread of silk may in fact be extended to the bottom of the ocean. This permits of the use of a line, which may be coiled compactly within a small space, the strength of the line being made just sufficient to insure its being hauled in with safety, bringing up at the same time the specimen-box and the register. The strain brought upon it, in hauling in, will depend upon the velocity, of the upward motion, which may be regulated accordingly.

Secondly, a *rapid* and *uniform* descent being secured, the indications of a revolving register will be reliable when attached to this plummet; while in the present mode of sounding the slow motion of descent at great depths, renders such a mode of registering the depth uncertain and unreliable.

Thirdly, there being no strain upon the line in the descent and the motion being *uniform*, it is practicable to determine the depth by the *time of descent*, making use of a small insulated wire as a sounding line, and determining the instant that the weight strikes the bottom by an electrical signal transmitted through the line. An apparatus was devised as long since as the year 1845, for ascertaining the moment when the weight strikes the bottom, by electricity, but in the mode of sounding heretofore employed, no particular advantage would result from this, while the danger of breaking the electric continuity is very great owing to the strain brought upon the line in the descent; and the plummet as now used descends with such a varying velocity, that even with the time of descent given, no calculation will give the depth. The method has therefore never been put in practice. Whereas, in the method proposed, there is no strain upon the line in its descent, and the plummet will fall through each successive hundred fathoms in the same time; *the time of descent will thus furnish a simple means of calculating the depth.*

In this process it will not be necessary to recover the line, and the time required to sound the ocean at any point, need only be that required for the plummet to sink to the bottom, moving with any velocity which may be desired.

I have made many experiments on the best method of coiling the line so as to secure its uncoiling with certainty, and without the possibility of strain upon the line, or the occurrence of a kink.

I have also given much attention to the quality and size of line to be used: upon these points, the practical working of the apparatus in a certain degree depends, but being merely mechanical questions they are easily settled. They are fully discussed in the description which accompanies the drawings.

The importance of the problem, which is thus sought to be solved, in connection with the survey of the coast, has never been questioned. A knowledge of the configuration of the bottom of the sea, adjacent to the coast, is necessary to the solution of many questions of importance to navigation, and to science, and especially that of the ruling feature of the Atlantic coast, the Gulf Stream; but besides these considerations the question has become one of great public interest in connection with the laying of submarine telegraphs; the risk of such enterprises being diminished in proportion to the accuracy with which the depth of the sea is known at every point of any proposed

line; and the ultimate practicability of such operations across the Atlantic being yet to be demonstrated by new and more accurate soundings.

DESCRIPTION.

The accompanying plate is a photographic copy of a drawing made from the first instrument constructed. Some slight modifications have since been made in the mode of attaching the register but without affecting the general design.

PLATE I.

Fig. 1. Represents the plummet as it appears in its descent.
T, the tube or case containing the coiled line.
W, the leaden or iron weight inserted in the bottom of the tube.
C, the conical cap.
R, the register in its place upon the cap.
L, the line.

Fig. 1 *a*. Represents a longitudinal section of the tube, weight and cap; showing the mode of coiling the line in balls, and the small specimen-box *s* passing through the hollow weight.

Fig. 2. Represents the register on a larger scale.
h h, the helices or blades.
r r, the register wheels.
g g, the locks for gearing and ungearing the wheels.

Fig. 2 *a*, represents the plan or horizontal view of the register, it being constructed so as to offer the least resistance in passing through the water.

Fig. 3, shows the detailed construction of the register wheels, and the helices.

From fig. 1, it will be seen that the form of the apparatus admits of rapid motion through the water. The weight is conical and elongated and the register presents the edges only, of brass plates to the water, and the line being uncoiled and discharged from the tube, there is no retarding force to the descent, from the line itself. Any desired velocity of desent may be given to the plummet by increasing or decreasing the weight W.

Fig. 1 *a*, shows the method of coiling the line.

There are various modes of doing this which are in common practice in twine and cotton factories; that which is here exhibited is the method of coiling in balls; all the balls exhibited in the tube being formed of one unbroken line, the line drawing out from the centre of each, until it is all drawn from the tube. The machinery for winding these balls is very simple; a drawing of that which I have used is herewith enclosed.

The essential points in the coiling are to coil the line in as compact a space as possible, and so as to ensure a certainty of discharge without danger of kinking. Two other modes of coiling are now under consideration, either of which may be better than the method by balls. One is to wind upon a spindle, and the other to lay the line in a sort of compound coil, directly in the tube. All these methods are now practised in the factories on a large scale, for winding twine and cotton.

The line used should be about five hundredths of an inch in diameter and as strong as it can be made of that size. A braided line of Holland

or silk of five hundredths of an inch in diameter, may be made to a strain of 40 or 50 lbs.; which is abundantly strong for the pur- as the weight and case are left at the bottom, the register and speci- tube only being brought up.

ube.—The tube may be made of tin in sections of eighteen inches h, with stove-pipe joints and bayonet fastenings. The object of this adapt the length of the tube readily to the amount of line which it contain. A tube four inches in diameter will contain nearly a mile ie to each foot of the tube.

nker and Specimen-tube.—The sinker is made of cast iron or lead of desired weight, depending upon the desired velocity of descent. A ht of 25 lbs. has been adopted. The sinker is conical and is inserted the lower end of the tube containing the line and fastened to this by screws or by a bayonet joint and fastening. The weight has a al hole or cavity through its entire length, through which the small men-tube passes in the manner shown in the drawing. The speci- tube is a tube of thin brass passing through the weight and attached e lower end of the line within the large tube. This specimen-tube ed with a valve opening upwards in the bottom, which closes when ube is drawn up, thus retaining the mud which is forced into the when the weight strikes bottom. The specimen-tube fits loosely in ollow of the weight, so that it may be easily drawn out as the line uled in.

ap.—The cap is used for two purposes; to contract the upper end of ube containing the line, so that the line cannot rise in bulk out of ube, and for supporting the register. It is formed in the shape of rustum of a cone, cut away on one side as well as open at the top, to allow the line to be discharged freely. A flat strap is fastened e top of the frustum nearly in the line of the axis of the tube, and this strap the register is set as shown in the drawing; the register pt in its place by loose collars.

gister.—The apparatus for measuring the depth consists of a helix rved blade attached to a vertical axis, and wheels gearing into an ss screw upon this axis. The revolutions of the helix caused by the on through the water are communicated to the wheels which are uated so as to indicate the number of revolutions of the helix.

vo registers are attached to one plummet by attaching them together e manner shown in fig. 2, by means of brass plates. The blades are to turn in opposite directions and will operate as checks upon each , and also counteract the effect of any rotary motion in the plummet. ie construction of the blades and wheels and the mode of gearing with the endless screw are shown in fig. 3. The wheels are differ- l wheels, that is, they are concentric, one of them having one hun- teeth, and the other one hundred and one teeth. The cross-bar (*b*) slight motion carrying with it the wheels; this motion is governed spring *s*. To gear the wheels, the cross-bar is pressed towards the ss screw until the teeth gear with that screw and the bar is there d, as shown in fig. 2, at *g g*. The revolution of the blade will now both wheels to turn, and after one hundred revolutions the wheels be found separated by one tooth or one division. The differences measure hundreds of revolutions.

In the register from which the drawings were made, the blades revolve once in two feet; one hundred revolutions will therefore correspond to two hundred feet, or one division of the scale of the register to thirty-three fathoms.

When the register is hauled up, the arms at *g g*, fig. 2, drop, and the springs cause the wheels to ungear and fly back, where they are held motionless by a projecting point at *n*, fig. 3. The arms are made to drop by means of a small wire which is attached to the cap as shown at *u* fig. 1; this wire is fastened to, or hooks over the ends of the arms, and when the register is drawn off, the arms fall.

Mode of attaching the line to the register and specimen-tube.—Before the line is put into the tube it is attached to the specimen-tube at a point four or five feet from the end of the line, the spare end is passed through the tube, and when the balls are all put in the tube the extreme end of the line coming out at top is attached to the register, after taking a few turns round the top of the strap, the register being in its place.

The line is thus attached to the register and specimen-tube only, and not to the large tube or weight. When the plummet strikes the bottom a part of the line will remain in the tube coiled; by hauling in the line this part will however be uncoiled, and on coming to the bottom of the coil, the specimen-tube will be drawn up through the large tube, and after the specimen-tube comes out the register will be drawn off the strap, and thus the large tube and weight will be disengaged from the line, specimen-tube, and register; and by continuing to haul in, the register and specimen-tube will be brought to the surface.

The plummet on striking will, under most circumstances, remain sticking in the mud in an upright position.

ART. II.—*Notice of New Localities, and interesting varieties of Minerals, in the Lake Superior region: supplementary to the chapter on this subject, in Part* II. *of the Report of Foster and Whitney;* by J. D. WHITNEY.

SINCE the publication of the second part of our "Report on the Geology of the Lake Superior Land District," in 1851, some materials, illustrative of the mineralogy of this region, have accumulated in my note-books, which, in the present communication, I have put together in the alphabetical order of the minerals noticed, for convenient reference. A few of the facts here stated were communicated to J. D. Dana, for the last edition of his "System of Mineralogy," and are here repeated, with some additional remarks on the general mode of occurrence or economical importance of the ores and minerals mentioned.

Analcime.—This mineral is quite abundant on Keweenaw Point, and has also been noticed by me on Michipicoten Island; it does not appear to have been observed in the Ontonagon region. The finest locality, however, by far, is at the Copper Falls

and Northwestern mines; and, especially, at the last-named place, where work is, for the present, suspended. Both these mines are, in fact, on the same vein, the Copper Falls mine being to the north, and the Northwestern to the south of the great belt of crystalline, unproductive trap, which runs through the middle of Keweenaw Point. In this vein, analcime occurs in large and almost transparent crystals forming geodes in the greenish magnesian silicate which is the principal gangue of the vein. These crystals are all trapezohedrons, and sometimes occur an inch in diameter; they occasionally have a thin incrustation of chrysocolla. The analcime, at this locality, is almost always associated with the peculiar form of orthoclase, so common in the copper region, and which will be noticed farther on.

At the Old Copper Falls vein analcime has been found in radiated-fibrous as well as granular-massive forms, and of a bright red color.

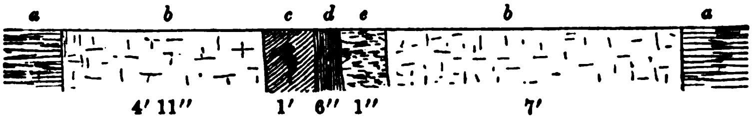
Apophyllite.—The foliated variety, or ichthyophthalmite, was found in great abundance in 1853 in the rubbish thrown out at the workings on the Prince vein, on the north shore. A variety in small, brilliant, deep-red crystalline scales or spangles, disseminated through calcite, forms curious and elegant specimens. The most usual occurrence of apophyllite at this locality is in large contorted plates, somewhat resembling the variety of calcite known as argentine. Crystalline specimens are occasionally met with at the Cliff mine, but none have been noticed in the Ontonagon district.

Barytes.—There are numerous veins of sulphate of baryta on the north shore of the Lake, and especially along that portion lying to the northwest of Isle Royale, as also on that island, and the smaller ones which lie near the main land to the westward of Thunder Bay. These veins vary in width from a few inches to several feet, and are usually made up of quite compact barytes without crystallization, and destitute of accompanying metalliferous ores.

The famous "Prince vein," on Spar Island, is one of the most conspicuous and interesting objects, at least in the eye of the mineralogist, in this region. As it makes its appearance on the south side of the island, on the precipitous face of the trap cliffs, which rise nearly vertically from the water, it may be seen from a distance of several miles out on the lake; and when shone upon by the sun, resembles a magnificent waterfall, its brilliant white contrasting strongly with the dark color of the trappean rocks in which it is enclosed.

The course of this vein is about N. 32° W., or nearly at right angles to the general trend of the coast of this portion of the lake. At the southern edge of Spar Island it is fourteen feet

and seven inches wide. Here the vein is made up of bands of calcite, crystalline quartz and barytes, as represented by the annexed cross-section.



a, a, trap; *b, b,* coarsely crystallized calcite; *c,* barytes; *d,* calcite with copper pyrites; *e,* quartz and calcite.

At the point where this section was taken the ore is confined to a band of calcite in the centre of the vein and about six inches in width. The metalliferous portion of the lode consists here of chalcopyrite and erubescite,—in small quantity, however, as compared with the amount of barren veinstone connected with these ores.

On the main land, about two miles distant, the vein reappears a little way back from the shore, where it is much split up; but when followed a few rods farther to the northwest it concentrates again, and appears to have a width somewhat greater than on Spar Island. A drift has been carried in on the vein for a distance of 165 feet, from which most magnificent crystallizations of amethystine quartz and calcite were obtained. An examination of the back of the drift shows that if workings should be resumed here, a rich harvest, for the mineralogist at least, would be gathered, the veinstone being highly crystalline in its texture. The metalliferous contents, however, seem to be chiefly limited to blende. At the point in the level where a winze has been sunk to the depth of 90 feet, and near the collar of the winze, a considerable quantity of native silver was obtained in fine laminæ between the joints of the blende. A large sum of money was expended here, after the discovery of the rich bunch of silver, but it does not appear that a second one was ever struck. A single minute point of native silver rewarded our patient search of hours among the veinstone for proof of the existence of the precious metal.

In no other vein in this neighborhood were any interesting crystalline minerals observed, although the exposures on the lake shore are usually good.

Chalybite.—This mineral has been observed by Dr. G. H. Blaker in the talcose slates near Marquette; it forms narrow strings and bunches in the veins of milky quartz which ramify through the slates. The quantity is not sufficient to make it of any economical importance.

The same mineral occurs, associated with chalcopyrite, in the quartz veins at Echo Lake, near Saut St. Marie. The geological position of these veins is the same as that of the Marquette slates.

Chrysocolla.—Handsome specimens are found in the Copper Falls vein, forming delicate stalactitic incrustations on the veinstone, and sometimes coating the crystals of analcime.

Chalcopyrite.—Veins of quartz containing this ore are numerous in the trappean rocks of the Azoic series, in the neighborhood of Echo Lake, about 15 miles east of Saut St. Marie. Copper pyrites is the predominating ore at the Bruce and Wellington mines on Lake Huron: it has also been found in veins in the Huron Mts., on the south shore of Lake Superior, where no mining has yet been carried on.

Copper.—The native metal is now the exclusive object of mining enterprise on Lake Superior, no veins producing *ores* being now worked, on either the north or the south shore. The sulphurets, however, are still mined on Lake Huron, in the Azoic rocks, a formation which has not been proved as yet on either shore of Lake Superior, to contain any workable vein of the native metal.

The largest mass of copper yet discovered on Lake Superior was in the 10-fathom level of the Minnesota mine, on the so-called "conglomerate lode," or the copper-bearing vein which lies between the trap and a thin bed of conglomerate that runs through the mining ground, and which has been opened to a depth of between 80 and 90 fathoms without ceasing to produce largely. This mass was 46 feet long, and is said by the superintendent of the mine to have weighed about 400 tons: a single cut across it exhibited a thickness of six feet of pure metallic copper. This mass was estimated to contain at least 90 per cent of the pure metal. The operation of cutting it up lasted thirty months.*

Almost all the specimens collected on Lake Superior as *crystallized copper*, are, in reality, not actual crystals, but only imitative forms produced by juxtaposition with the crystalline faces of some mineral substance, and usually of calcareous spar. The large masses which are seen in collections, and labelled "crystallized copper from the Cliff mine," usually exhibit only a few indistinct planes which can be referred to the crystalline force of the metal itself.

The finest groups of crystals ever obtained in the copper region were from the Old Copper Falls mine, a locality which has long ceased to be worked; and no other has furnished any specimens to compare with those found here.

The predominating form in these groups was the rhombic dodecahedron; but the octahedron was not of unfrequent occur-

* The size of the pieces into which the great masses are cut for convenient handling under ground and shipment is now much greater than it was formerly: blocks of copper weighing from 8000 to 9000 pounds are not unfrequently brought to the surface and sent off to the smelting works.

rence. The diameter of the perfectly formed crystals rarely exceeded one-fourth of an inch, although single crystals from this locality, octahedrons, have been seen as large as an inch across their bases. The finest single crystals, as far as ascertained, are from the Cliff mine, and are tetrahexahedrons. One in my collection, considered by many the most beautiful crystal ever found in the Lake Superior region, is about three-fourths of an inch in diameter, and nearly perfect.

The occurrence of native copper as a pseudomorph after aragonite, reported by Söchling* as from Lake Superior, may with the strongest probability be set down as an error. It is very likely that the pseudomorph in question was from Corocoro, South America, where interesting ones of this kind do occur. There is a very great tendency to confusion in the localities of American minerals sent to Europe, as every mineralogist on this side of the water has learned by experience. No aragonite has ever been found in the copper region, as far as I know. Native copper, as a pseudomorph of calcite, has been noticed by me in a single instance, in a specimen from the Old Copper Falls vein.

The specific gravity of the native copper, sawn from the interior of a large mass of the chemically pure metal, has been previously stated in our Report at 8·838; this is lower than that given by Erdmann and Scheerer† as the specific gravity of crystallized copper. The specific gravity of the copper smelted at the furnace near Detroit was found to be considerably less than that of the native metal. A piece sawn from the centre of an ingot, and showing no signs of any air-bubbles, gave a specific gravity of 8·601; another portion of the same ingot taken from near the surface gave 8·570; both pieces appeared, under the magnifying glass, equally free from bubbles.

This copper, which was smelted from masses brought from the Toltec mine, was found on examination to be chemically pure, with this exception, that it contained $\frac{3}{10000}$ of silver, about seven ounces to the 2000 lbs.

Datholite.—Fine crystals of this mineral have been found only at the locality on Isle Royale, which has long since ceased to be worked, the island being now entirely deserted by all except a few fishermen. There are several localities on Keweenaw Point, however, where it occurs in great abundance, but not, so far as I have observed, in handsome crystallizations. The gangue of the Hill vein, on the Copper Falls location, consisted, in a portion of its more northern extension, of a greenish magnesian silicate penetrated, in every direction and sometimes forming a sort of breccia, with branches and strings of datholite. It is usually massive, translucent, highly vitreous in lustre, and of a light

* Pogg. Ann., civ, 332.

† Erdmann and Marchand's Journal, xxvii, 194.

-red color, owing to the presence of a minute quantity of
xyd of copper diffused through it.
ıe veinstone of the Ontonagon region had seemed to be
destitute of this mineral, and it was not until last summer
it was discovered by me in that district. At the Minnesota
, among the vein-stuff thrown out, some singular nodules
observed looking like rusty cannon balls. On breaking
of these open and examining it, it was found to be datholite,
singular and hitherto unobserved form.
ıe mineral is quite compact, breaking with a conchoidal
ure, perfectly white, opaque, and resembling in its physi-
character the purest and most close-grained marble. Its
ness $= 4·5$; specific gravity 2·983.
n analysis of this mineral by Prof. C. F. Chandler, gave the
wing results:

Silica,	37·41
Oxyd of iron and alumina,	·35
Lime,	35·11
Boracic acid (by loss),	21·40
Water,	5·73
	100·00

ıe quantity of datholite which is found on Lake Superior is
considerable, but it does not occur as a constant ingredient
ıe veinstone in any of the large mines now worked; and it
t probable that it will become of economical value for the
ıction of the boracic acid it contains, however interesting it
be in a theoretical point of view, as connected with the
n of the cupriferous veins.
ematite.—The purity of the mountain masses of iron ore,
h are now extensively mined at various points from 14 to
ıiles west of Marquette, may be inferred from the following
yses recently made of specimens from the three principal
s, or quarries, as they may more properly be called. The
imens are, indeed, selected ones; but an inexhaustible sup-
of ore of the same quality could be obtained, without reject-
ny considerable amount of the stuff which is quarried out,
it desirable to ship a perfectly pure ore. The average
of the ore shipped would, in point of fact, fall but little
that given by the following analyses.

	I.			II.		III.	
	a.	*b.*	*c.*	*a.*	*b.*	*a.*	*b.*
nsoluble,	1·02	·80	·54	7·92	7·96	1·99	2·05
ron,	69·41	70·22	69·96	64·42	64·01	68·81	
)xygen and traces of lime, &c.,	29·57	28·98	29·50	27·66	28·03	29·20	

is ore from the Jackson, II. from the Cleveland, and III.
the Burt or Lake Superior mountain. The fragments an-
ed were, in each case, broken from the different portions of

the same large specimen, one object being to ascertain what the variations in the quantity of oxygen were, in different portions of the same mass. I. *c.* is the mean of three closely-agreeing determinations.

In the above analyses, the iron having been precipitated from the chlorohydric acid solution by ammonia, the filtrate was evaporated to dryness and ignited, and in no case did the residuum amount to more than a few hundredths of one per cent. In I. *c.* and III. *b.* there was a weighable quantity of lime present, amounting, in each case, to 0·05 per cent. It was not possible, in any instance, to obtain a weighable amount of alumina. The oxygen was therefore determined by the loss, as giving more accurate results than could be obtained by the process of reduction with hydrogen. It appears, therefore, that these ores are mixtures of the peroxyd with a minute and varying portion of the magnetic oxyd.

Both the Burt and Cleveland Mountain ores show minute crystals of magnetite scattered through their mass; in the Burt ore these crystals are from $\frac{1}{16}$ to $\frac{1}{12}$ of an inch in diameter; in the Cleveland, so small as to be hardly visible without a magnifying glass. No sulphur or arsenic could be detected in any of the specimens examined. The insoluble portion consists of silica, with only traces of lime, alumina and magnesia: this silica is partly in combination with the iron in the form of a silicate of iron, and partly present in the form of grains of quartz. On the whole, it may be said with truth that these ores surpass in purity any known to exist elsewhere in the world in anything like the same quantity.

Leonhardite.—This mineral has been observed only in the Old Copper Falls vein, where it was very abundant; but a careful investigation would probably reveal its presence at other localities. An examination was made of this mineral to ascertain at what temperature it parts with a part or all of its water, with reference to H. Rose's investigations on Laumontite, which he has shown to lose a portion of this constituent at 100° C. The results gave on the mineral in small fragments:

Dried at	Loss of weight.
80°	1·46 per cent.
90°	0 "
100°	0 "
Ignition,	11·89 "

The 1·46 per cent is probably not essential to the constitution of the mineral; the loss by ignition agrees well with the formula which takes the oxygen ratio of the bases and silica as 4 : 9, and 12 $\dot{\text{H}}$.

Limonite.—This ore of iron has recently been discovered and for the first time on Lake Superior in any noticeable quantity.

rs at the Jackson iron mountain, where it forms beds of feet in thickness, occupying depressions in the anhydrous m the decomposition of which it may have been formed. alysis gave the following results:

Silica,	6·54
Iron,	60·03
Water,	9·31
Oxygen and traces of lime and magnesia,	24·12
	100·00

sulphur or manganese could be detected; the original ore s to have been only partially converted into limonite, as antity of water given by the analysis is considerably less hat required to form a hydrous peroxyd of iron. It is t the Pioneer Furnace, near the Jackson Mountain, and ered to aid in the reduction of the ore.

ganite.—Handsome specimens of this mineral were given Dr. G. H. Blaker, of Marquette, as having been procured vicinity; the exact locality is not known to me.

el and Copper, arseniuret of.—This is the same mineral no-y T. S. Hunt (this Journal, [2], xix, 417), and afterwards fully described in the Report of the Canada Geological r, 1853–6, p. 388. The result of my analyses, made two go, confirm entirely those already published by Mr. Hunt; neral, which appears homogeneous in composition, being a mixture of the arseniurets of copper and nickel.

analyses of different specimens broken from the same gave as follows:

	I.	II.
Arsenic (by loss),		47·01
Copper,	14·56	20·94
Nickel,	33·35	31·24
Silver,		·24
Gangue,		·57
		100·00

cific gravity 7·527.

I. the quantity of arsenic required to form with the cop-meykite, and with the nickel copper-nickel, is 47·86 per which agrees pretty nearly with that given by the analysis. specimens obtained by me on Michipicoten island in 1853, coarsely crystallized calcite, and form nodules having a ure in concentric layers. The portions selected for analy-peared perfectly homogeneous and had almost exactly the and general appearance of copper-nickel. This ore was ed in mining for silver on the island, from the trappean ; but on examining the excavations it did not appear that was any regular vein of this or any other metalliferous al, the ore occurring in irregular nodules disseminated gh the trap. There is little reason to believe that either

nickel or silver occur at this interesting locality in suffic quantity ever to become the object of a profitable mining ei prise. The beds of rock appear to be too thin, and their cha: of lithological character too sudden, to admit of the developn of well characterized veins.

Orthoclase.—In almost every collection of Lake Superior s] mens may be seen bunches and geodes of minute reddish c tals, accompanied by native copper, calcite and the zeolites, usual vein-minerals of that region; these crystals are usu labelled "stilbite," but they are, in reality, orthoclase, as is dent from their physical characters and chemical compositio

The mineral here referred to, which has, on casual inspect but little resemblance to feldspar, is the same one noticed page 102 of our Report, where an imperfect analysis of i given. The peculiar interest attaching to this anomalous oc rence of the substance in question seemed a sufficient reason completing its analysis, and adding some further remarks oı associations.

This mineral occurs in minute crystals which are rarel much as one-tenth of an inch in length; they are rhor prisms, but not very distinct, or brilliant enough to be measu by the reflecting goniometer. The angle of the prism is al 118°, or near that of *I* on *I*, in common feldspar. The term tions of these prisms are usually rough and indistinct, but forı by a single plane, probably 1*i*; more frequently the crystals aggregated together into a confused crystalline mass, the i viduals being too minute and ill-defined to be made out witl a magnifying glass. The mineral agrees in its physical cha ters with orthoclase, fusing before the blowpipe with some (culty to a blebby glass.

The analysis gave:

Silica,	65·45
Alumina,	18·26
Oxyd of iron,	·57
Oxyd of manganese,	*trace*
Potash,	15·21
Soda,	·65
	100·14

The above results indicate, beyond the possibility of a do that the mineral is really orthoclase.

The occurrence of feldspar as an associate of, and in intir connection with, the zeolitic minerals, which form so lar portion of the gangue of the cupriferous veins, and, indeed presence at all in a vein-stone, is a matter of too much imp ance not to be dwelt upon. Instances of this kind are, as sufficiently rare, and there are some points connected with occurrence of the feldspathic element in the Lake Supe veins which add to the interest with which these specimens invested.

Orthoclase has been recognized and described as occurring in the mineral viens of Schemnitz and Kongsberg,* although the possibility of such an association has, until within a few years, been hardly allowed. The well-established fact of the existence of feldspar as a pseudomorph, of the form of laumontite and of analcime, in the trap of the Kilpatrick Hills, near Dumbarton, Scotland, furnishes incontestible evidence of the possibility of the formation of this mineral in the moist way, and the phenomena exhibited on Lake Superior in connection with the association of feldspathic and zeolitic minerals, point as clearly to this conclusion as they do to the necessity of rejecting the igneous theory of the origin of the veins themselves.

The variety of orthoclase of which the analysis has been given above is found in almost all the mines, from the extremity of Keweenaw Point to the Ontonagon; but in the latter district it is most abundant. At the Northwestern mine, the association of orthoclase and analcime is almost constant, and there are few geodes which do not exhibit delicate crystallizations of the first-named mineral so situated with reference to the other as to lead to the conclusion that their formation must have been going on at the same time and under the same circumstances. The crystals of orthoclase are also, at this locality, frequently scattered, singly, over delicate incrustations of a very soft magnesian mineral, which hardens somewhat on exposure to the air, and which is probably saponite, but of which I have never been able to procure enough for an analysis. This mineral seems to have been the last formed of all the vein-minerals of this region.

At the Old Copper Falls vein, orthoclase, of a bright red color, occurs lining the interior of cavities in the gangue, and forming with associated calcite and crystallized copper, specimens of great beauty. The calcite, not unfrequently, has crystallized over the orthoclase in such a manner as to be colored deep-red by it. The same may be said in reference to the joint occurrence of natrolite and orthoclase at this locality. There is clear evidence here of the contemporaneous formation of the copper, natrolite, calcite and orthoclase.

In the Ontonagon region, the minerals associated with orthoclase are chiefly quartz, epidote and calcite. At the Aztec and Ridge mines, geodes lined with delicate crystallizations of these are not unfrequent. Minute crystals of scolecite or natrolite have been noticed in the same connection. At the Minnesota mine, the large crystals of quartz, formerly obtained there in abundance, were frequently encrusted with a thin layer of crystals of orthoclase.

It may be remarked, that the crystals of this mineral are, throughout the whole copper region, remarkably uniform in

* See Leonhard and Bronn's Jahrbuch, 1850, p. 43; also Bischof's Geology, ii, 330.

their size, color, and general habit. They are rarely more t a few hundredths of an inch in length, have the same crystal form, and are, with rare exceptions, of a light reddish color.

Feldspar, in no instance, so far as has yet been observed, fo the bulk of the veinstone; it is only met with in comparati minute quantity, although occurring in numerous locali Only a single instance has been noticed where a crystal h length as great as one-tenth of an inch, and this was an im fectly formed one.

Note.—Weissigite, described by Jenzsch, is undoubtedly thoclase, as suggested in Dana's Mineralogy, p. 513; this found in a porphyritic amygdaloid, with chalcedony and qu and is spoken of by Jenzsch as the first known instance of occurrence of a feldspathic mineral in an amygdaloidal ca of a rock of this class.

Serpentine.—Well-characterized serpentine has not yet t found in the Lake Superior region; but a substance closely lated to this mineral, and, in fact, differing from it chiefly the substitution of protoxyd of iron, in a large but vary amount, for a portion of the magnesia, forms the head-lan Presqu' isle, near Marquette. An imperfect analysis of this was given in Foster and Whitney's Report, Part II, page Since the publication of that analysis new specimens have t collected, and a more thorough examination made of it, of wl the results here follow.

The substance is of a deep green color, so deep as to ap almost black; its powder is light greenish-gray. Its hard is a little above that of common serpentine. It is readily tracted by the magnet, when broken into small fragments. some specimens minute octahedral crystals of magnetic iron disseminated through the mass can be seen with the aid of magnifying glass. The substance is readily attacked by chl hydric acid, even in the cold, if finely pulverized; but a s portion of unattacked mineral remains behind when the ins ble residuum is treated with carbonate of soda in the usual v It amounts to from two to six per cent, and appears to be ar soluble silicate mechanically mixed with the serpentine; i probably hornblende, but has not been analyzed.

The analyses of three specimens collected at some dist from each other, gave the following results, as the composi of the soluble portion of the substance:

	I.	II.	III.
Silica,	36·95	37·25	
Magnesia,	33·07	28·67	14·83
Soda,	·97	1·16	
Protoxyd of iron,	16·50*	14·14	19·52
Peroxyd of iron,		6·75	12·90
Water,	10·40	10·89	
		98·86	

* Estimated as protoxyd.

In analysis II, in which all the ingredients are determined, as well as the relative amount of the oxyds of iron, the calculation gives, for the ratio of the oxygen of water, protoxyd bases and the silica, leaving out of consideration the peroxyd of iron as being a mechanical intermixture, the numbers 1 : 1·49 : 1·99; or, almost exactly, 1 : 1½ : 2, which is the ratio given by the analyses of serpentine.

Silver.—Native silver still continues to be found in considerable quantity, in connection with the copper, at the principal mines on Lake Superior, especially at the Minnesota and the Cliff. The amount obtained at the Minnesota in 1857, by the company, was $655.44: this, however, was but a small portion of what was really found, as the miners are well known to appropriate almost all the silver they discover. The metal has never been noticed by me in distinct crystals, except in one instance, namely, at the Copper Falls mine, where a few well formed cubes about one-tenth of an inch in diameter were obtained.

Most of the fine specimens of silver from the Lake have been associated with calcite, which is dissolved away by an acid, leaving the metallic mass exhibiting the impressions of the planes of this mineral, as is the case with the copper specimens, as before remarked.

Zeolites.—To close this article, a few remarks may be added on the occurrence of the zeolitic minerals in the Lake Superior region, and especially as vein-stones.

By far the most abundant zeolites of the copper-bearing veins are prehnite and laumontite, or the closely allied species, leonhardite. The cases are rare, however, in which either of these minerals constitutes the bulk of the gangue of a vein, except in the case of narrow strings and bunches of limited extent. Quartz and calcite are the predominating vein-minerals, the zeolites being decidedly subordinate to these, especially in the great, productive lodes. The zeolites, moreover, are chiefly confined to transverse veins, or those crossing the formations at a high angle: in the Ontonagon region, where the great lodes have the same strike as the beds of rock, zeolitic minerals are of comparatively rare occurrence in the vein-stone. In this class of veins quartz and silicious material greatly predominates over all the other minerals, and there is much more rock intermixed with the vein-stone proper. Datholite may be noticed in a few instances among the transverse veins, as forming the larger portion of the gangue near the surface; but in no such case has mining been carried to any considerable depth, so as to ascertain how far this state of things continued.

On the whole, the diminution of the zeolitic portion of the vein-stone is marked as the mines are extended downwards: the only crystalline mineral observed in a recent careful examination

of the Minnesota mine, at a depth of from 70 to 80 fathoms, was calcite. Traces of what appeared to be laumontite were noticed along the selvages of the lode, which at this depth is quite as rich in copper as anywhere above, but the lode seemed to be very compact in its texture and no other zeolite was seen in it.

The entire, or almost entire, absence of some of the more common zeolites from the Lake Superior region is worthy of notice. Those minerals which are most characteristic of the Nova Scotia trappean rocks are almost entirely wanting on the Lake. Neither chabazite, stilbite or heulandite have ever been observed by me in the copper region, on the south shore of the Lake.* The analogy of lithological character between the traps of Nova Scotia and those of Lake Superior, which has frequently been urged as a reason for considering them of the same geological age, and which has not yet been made evident by an analysis of the rocks themselves, fails entirely when considered with reference to the associated minerals.

Of the zeolites occurring on Lake Superior, pectolite, leonhardite and chlorastrolite appear, thus far, to be limited to a single circumscribed locality, while harmotome is reported in only a doubtful crystal. The only new zeolitic mineral noticed is chlorastrolite, which is quite common along the beach of Isle Royale, for a distance of two or three miles, but which has not been discovered at any other point on the Lake.

The occurrence of the zeolites on Lake Superior is not absolutely, although chiefly, confined to veins. All the fine specimens of crystallized minerals of this class have been obtained from the cupriferous veins, so that this may be considered as the normal mode of occurrence in this region. Where the trappean rocks assume an amygdaloidal structure, we have, occasionally, prehnite, chlorastrolite, etc., in radiating fibrous masses, filling the cavities; but quartz in the form of agate and chalcedony and calcite are much more common. There are occasional flat tabular masses of laumontite mixed with prehnite found lying in the direction of the lines of bedding of the trap, but these are thin and of limited extent. Many of the trap amygdules are filled with a mineral resembling chlorophæite and others with saponite. Most of the substances thus occurring are only to be recognized by chemical analysis, as they are generally finely fibrous or massive.

* These minerals are reported by Messrs. Owen and Norwood as occurring on the Minnesota shore of the Lake, west of Pigeon River, a region to which my explorations have not extended. I have, however, examined numerous specimens from that part of the Lake, without having discovered either of these zeolites.

—*On some questions concerning the Coal Formations of North America;* by L. LESQUEREUX.

perhaps be said that as everybody is now acquainted oal, with its essential constituents and the general laws nation, an attempt to offer to science something new nteresting on the subject, must prove a fruitless task. rtion has a semblance of truth only, for it is certain of the various and most important phenomena con ith the formation of coal are not satisfactorily, nor even lained. And as they are continually brought forward sion, either by lecturers or systematic geologists, the f the formation of coal, considered as a whole, has been in such a manner that it is doubtful if the most essen- on the subject, some of which may be considered as able, are not still looked upon by many as hypothetical vidual opinions. It is with these peculiar phenomena al formations, and consequently with the exposition and ssion of geological facts connected with them, that we leal in the first part of this paper.

cannot expect to come to a right understanding of the of coal without some acquaintance with the vegetation remains it is made, our attention must necessarily to ent be directed to the flora of the coal period. But it ough to know the peculiar nature, the anatomical and constitution, of the coal plants. It is necessary to study in their geographical distribution, in the different coal America and of other countries, and also in the suc- rata of the coal at different geological horizons. And be desirable also to examine the vegetation of the coal tion with other external influences, in order to become d if possible with the climatic conditions that prevailed ne of the coal formation.

lan that we propose to follow may accidentally direct ission to some points which do not appear to have a ation to the formation of the coal. But we must bear that geological eras are not very distinctly limited; or hat to have a true understanding of one of them it is sometimes to examine the causes that have prepared t may have brought it to a close.

ipposition that coal is a true mineral, formed in certain our globe only by some chemical agency and without ulation of wood grown on the surface and buried after- is been recently revived among us, though it had long n put aside, and apparently forever, as contradicted by pearances of the coal deposits and by the nature of the

coal itself. It would be useless, again to show the groundlessness of an hypothesis to which nature does not give the slightest apparent support.

The supposition that the matter of the coal (the wood) was heaped in some hollows or basins by the agency of water, as by currents of the sea or of some river, or by some other external cause, hurricanes, partial or general floods, sinking of the ground covered with thick forests, &c., has been also generally abandoned as contradicted by general evidence. The reasons against it may be briefly enumerated. They are found: 1. In the stratification of the coal measures; and also of the coal itself, which upon close examination appears to have been formed by successive layers of matter. 2. In the presence of plants in the coal and in the shales above it, plants preserved in the integrity of their most minute and fragile parts, and in a position which shows that they have been buried at the place where they have fallen from the trees or the bushes and where they grew. 3. In the absence in the coal of any matter foreign to it, of sand, of mud, &c., the ashes of the coal being generally in exactly the same proportion as in the wood. 4. In the thickness of some beds of coal containing a quantity of matter far greater than could be furnished by a buried forest.

The theory of the formation of the coal by the heaping of consecutive layers of plants and trees grown in place, preserved in water and buried afterwards; or the peat-bog theory as it is called by some, is then the only one admitted now as satisfactorily explaining the process of formation of the coal. The analogy of formation between the peat-bogs of our time and the beds of coal of the old measures cannot be called a theory; it is a demonstrable fact. We can now see the coal growing up by the heaping of woody matter in the bogs. After a while we see it transformed into a dark combustible compound that we name peat or lignite according to its age. We then see it hardening either by compression, or by this slow burning in water that has been so well explained by the experiments of Liebig. Most of the peat bogs of Europe, at least the oldest, have at or near their bottom some plates or thin layers of hard, black matter, that ocular examination or chemical analysis fail to distinguish from true coal. We find besides in Holland, Denmark and Sweden, thick deposits of peat separated into distinct beds by strata of mud and sand, giving the best possible elucidation of the process of stratification of the coal measures.

It is not only in their general features that both formations are so much alike. But in the minutest accidents and even local peculiarities, their agreement is clear and unquestionable to one who has studied the formations of the peat bogs of our time. We quote a few examples.

An author, speaking lately of the formation of the coal, mentions the presence in the coal of *wedge-shaped masses of vascular tissues found imbedded in the midst of the more structureless bituminous matter of the coal.* He accounts for this fact by supposing that these tissues are the remains of floated logs, which have finally become imbedded in the carbonaceous matter below. This supposition is rather an extraordinary one. If the coal has been formed like the peat bogs, there can not be any *floated* logs in the compound. If there were floated logs in the coal, this would take us back to the formation of the coal by transportation. In every peat bog, the process of burying trees is in constant operation. The preservation of the logs which cannot be covered with water when they fall on the ground, is due to the agency of a moss, the *sphagnum* which extends its compact tufts always saturated with water like a sponge, over every fragment of wood, from the smallest to the largest. The *Sphagna* work like the ants to bury their treasures; and as their growth is continuous and stopped only by the frost, the heaping of their own woody matter which forms the *structureless* peat added to the wood which they have to preserve and the other plants of the marshes gives an appreciable thickness for each year. In the peat bogs of Switzerland, peat grows at the rate of two inches per year, a thickness reduced to one half by compression. In the same peat bogs, the *Sphagna* do not require more than three years to cover the stem of a tree of moderate thickness.

The bogs then, even the largest, enter naturally and without transportation into the composition of the coal as they become part of the matter of the peat bogs. In the deep bogs of New Jersey, there is a class of woodmen whom I would call log-fishers, who sound the marshes with long poles, to find the sound logs which they dig out of the black and already combustible mould or peat, from a depth of from six to ten feet. Some old swamps of Northern Europe contain as many as four or five generations of trees of different kinds imbedded from twenty to fifty feet deep and separated by thick beds of compact, entirely decomposed woody matter or peat. Some of those bogs are so abundantly filled with sound and large logs of oaks, pines and birches, that their removal has gone on for more than half a century before there was any material diminution of the supply, and for a long time it was supposed and even maintained that the trees of those marshes were growing under ground.

The flattening of all the stems found in the coal and in its shales, and also the layers of bark observed in the same formations, without any trace of internal woody structure, have also attracted a great deal of attention and useless theoretical discussion. In the oldest peat bogs of Germany, especially in the large swamps or lignite-deposits of the Pliocene of Saxony, the

trees are found all softened and already flattened to a greater or less extent. Some of the buried forests of England show the same appearance. From some clay banks exposed by a slide in the Jura mountains, large trees of recent species, still living in the country around, have been exhumed, and though the wood still preserves its natural appearance and its tissues, it has lost its hardness of texture and has become as soft as the clay itself. Hence, as Liebig has proved by direct experiments, in the process of slow decomposition or rather slow combustion in water, the woody matter is generally softened before its hardening and entire transformation in coal.

In Denmark, there are immense meadows, extending for miles along the shores and covering old deposits of peat or combustible matter to a depth of from six to eight feet. The entire mass consists of a half fluid paste with layers of the bark of alder and white birch, rolled, flattened or pressed like the leaves of a book. Farther back in the interior of the country, especially in the royal park of Copenhagen, the formation of this kind of peat can be followed in all its details. First a thicket of alders and birches sprout out, covering an overflowed surface of ground. The thicket is impenetrable, and soon presents a confusedness of stems and interlaced branches. Then, as the trees become older, the whole mass begins to decay, especially at the level of the water, and by and by it falls down by its own weight, becomes submerged in a few years, and from its own seeds upon the mould of its half floating, half decomposed remains, a new generation of trees appears again and the process of formation is continued in the same way. The internal woody matter of the trees, the lignine, is decomposed at first and reduced to a paste, while the bark, impregnated with resins, is preserved for an indefinite period. In the coal basin of Trevorton, Pa., there is a perpendicular wall presenting to the eye a beautiful picture of prints of Lepidodendra and Sigillariæ, crossing each other in every possible direction, all thin layers of bark superposed without any woody or carbonized matter between. It is nothing but the surface of an old coal-swamp, formed like the peat bogs described above. The peat which it covered has formed the coal, and the woody matter floating in water above it has been mixed with mud and formed the shales.

If it is true, as we said before, that all the peculiar accidents of the coal formations can be thus exemplified and explained by phenomena now observable in the growth of the peat, is it not surprising that the peat-bog theory of the formation of the coal should be still exposed to so many contradictions, and especially be subjected to continual and hypothetical modifications, which, destroying its simplicity, render it then truly unsustainable. The following reasons have been repeated time and again. The

repeated succession of various strata in the coal measures, viz., the constant alternation of fire clay containing roots of trees, with coal and shales, both containing remains of land plants or of marine shells; with limestone containing madrepores and shells of the deeper seas; with sandstone mostly without any fossil remains: this alternation evidently shows that at the time when the formation was progressing, the sea was continually brought in contact with the coal and covered it most of the time. Hence it follows; that if the coal has been formed in marshes like our peat bogs, we ought necessarily to admit of a submergence and therefore of a subsidence of the land after each deposit of woody matter, and of an upheaval of the same land to bring it up again above the level of the sea for each successive growth of a new peat bog. This appears to some geologists an unaccountable and unnecessary use of nature's internal forces; a kind of *lusus naturæ*, resembling a miracle. To meet this objection, they have supposed that the peat bogs of the coal measures grew on the deltas of some large river, and therefore exposed to periodical inundations: that as fast as the peat grew, the river brought upon it mud and sand, the materials from which the shales and the strata of sandstone were formed: that, nevertheless, the deltas being by some *internal force* constantly sinking, they were consequently sometimes invaded by the sea which covered their whole extent and in the course of time, built upon them the strata of limestone: that as soon as these strata reached the surface of the sea (a fact which probably supposes that the movement of subsidence had stopped for a while) the land plants began to appear again, the peat to grow, and the matter to be heaped up till another large periodical inundation of the river brought new deposits of mud and sand; and thus by continuous subsidence and repeated inundations, the coal, shales, sandstone and limestone strata were alternately formed.

Before giving any reasons in support of the alternation of upheaval and subsidence as supposed by the peat bog theory, we will take the liberty to examine this new theory which we regard only as a poor modification of part of the former which it assumes to put aside forever. It is generally asserted that in the coal measures, the alternation of strata is the same in the whole extent of a basin, or in other words, "*that each stratum is generally horizontally extended over the whole coal-field in a continuous sheet, so that each seam is accompanied by the same strata above and below.*" This is only partly true. In the coal-fields of the United States, it is true only of some beds of coal and of one or two strata above the conglomerates. Every practical geologist knows well that it is impossible to identify the position of a bed of coal by means of its adjoining strata. If the same strata

had been expanded without alteration through the whole extent of a coal basin, nothing would be easier than to fix at once the geological horizon of each bed of coal after the close study of a single section. The shales above the coal give by their fossils the only reliable data; but in many places they (the shales) are entirely wanting and are replaced by sandstone or limestone. In the western coal-fields of Kentucky, the first coal below the Mahoning sandstone, or the fourth coal above the conglomerates (the same as the Pomeroy coal of Ohio or the upper Freeport coal of Pennsylvania) whose shales sometimes reach in the East a thickness of 10 feet, is immediately covered by the sandstone. There is scarcely a vein of coal worked to any great extent, that does not show a great diversity in the thickness, density and color of its roof shales. Hence the necessity of roofing differently the tunnel of a mine in different places according to the nature of the shales. The bottom clay is almost always present; but its thickness, color and density are also variable. The limestone of the coal is the most irregular of all the formations. It is mostly local, sometimes only in boulders, and its numerous variations in thickness, composition and even fossils, cannot be accounted for by any satisfactory general rule. There is not in the United States a single bed of coal that is unvariably covered with limestone. The sandstone is generally extended with more regularity; but it has also its diversities of thickness and local disappearance. The only bed of sandstone which appears to be continuous in the whole extent of the coal-fields above the conglomerates, is the Mahoning sandstone. Though its thickness is also somewhat variable, it is found topping the 4th coal (coal E of Lesley's Manual) from the anthracite basin of Eastern Pennsylvania to the western extremity of the coal-fields of Illinois and Western Kentucky. The Anvil-rock sandstone, topping the 12th coal of Western Kentucky, though generally of great thickness, has not as yet been identified in the East. For the coal itself, the assertion of its continuity could be admitted as nearly true.

Though a coal bed cannot be called a continuous sheet in its horizontality, since all the strata of coal are subjected to thinning or even entirely disappearing in some places and some others are circumscribed in narrow limits, generally speaking, most of our large beds of coal can be traced through the whole extent of the coal-fields. The great mammoth vein divides itself into three or four different beds in some places, but is found continually, thinning from Carbondale to the western limits of the Illinois coal-fields. The first coal below the Mahoning sandstone (the Pomeroy coal) is seen to have the same extent with scarcely any change in its thickness. The Pittsburg coal which from its high position in the coal measures has been washed away over

large surfaces, shows itself, along with the characteristic fossils of its shales, in every part of the measures where the thickness is sufficient to reach to its level. Thus we have some beds of coal generally accompanied, at least locally, by their peculiar shales, and one great bed of sandstone covering a surface as wide as the whole extent of the Appalachian and the Illinois coal-fields, an area of nearly one hundred thousand square miles.

In a short report on the stratigraphical palæontology of the Geological Survey of Kentucky, or rather in an introduction to a future palæontological report of the Survey of that State, I expressed the opinion that the Appalachian and the Illinois coal-fields were once continuous fields, and that the great axis of the Devonian and Silurian measures which separate them now, had been elevated at an epoch posterior to the formation of the coal. This opinion was not and could not be discussed in a short local report. I could there only give in support of it the fact of the identical distribution of the coal beds and of the coal flora in both basins. As it has been very courteously controverted in this Journal,* and especially as the discussion of this geological point enters into our subject and may help to satisfy the mind upon the value of the so-called new theory mentioned above, it is proper that I should briefly present the reasons in favor of my opinion.

It would be absurd to assert that the veins of coal or rather that the peat bogs of the coal formations were formed on a perfectly horizontal surface, and that the woody matter was deposited in the same thickness over the entire area. The most even plains have undulations on their surface; and the cross-section given in my report of a part of the Dismal Swamp of Virginia, should have explained my meaning. The peat bogs of our time are more or less broken or crossed by small elevations of sand or hills of some other deposit, which here and there break their horizontality and also their uniformity of features. For, although these irregularities may be scarcely elevated above the surface of the bogs, they are without exception, covered with a vegetation of entirely a different character from that of the peat bogs, and therefore their outline is perfectly definite. Sometimes groups of islands are thus seen rising in the middle of the bogs. Sometimes, also, as in the granitic country of the Hartz mountains, or in the basaltic region of the Rhoen mountains of Germany, peaks of granite or columns of basalt protrude like towers from some parts of the swamp. No one will contend that these irregularities break the continuity of a formation; or that the peat bogs on both sides of a hill of sand or around a block of granite are not a *continuous formation*. In a geological point of view, accidents like these cannot be taken into consideration.

* This Journal, vol. xxvi, p. 78, July, 1858.

But it is clear, at least to my mind, that the great ridge of Devonian and Silurian by which the Appalachian and the Illinois coal-fields are separated to a distance of from one to two hundred miles, cannot be regarded simply as one of those hills which separates two parts of a peat bog. We can discuss only these two alternatives: either the Silurian axis was not upraised at the epoch of the formation of the coal, and this formation, being in active progress upon the whole surface occupied now by the coal-fields and the Silurian and Devonian, was *continuous*, and consequently presented the same general features; or, the coal was formed on both sides of the ridge, and therefore in two separate basins, and then both formations, though of the same age, would have been subjected to some peculiar influences, and each of them would be characterized by some differences, either in the relative position of their coal beds, or in the composition of the strata, and especially in the distribution of their flora. The report of the Kentucky Survey shows on the contrary: that in both coal-fields, the coal beds are exactly in the same relative position; that at the same geological level, their shales contain the same species of plants; that from Eastern Pennsylvania to Western Illinois, the thinning of some strata preserves a perfectly regular progression, and does not show any change on one or the other side of the great ridge.

But there are some other reasons which may appear more conclusive.

1. The conglomerates, as also some beds of sandstone, especially the great Mahoning sandstone, are developed near the eastern limits of the coal-fields to a prodigious thickness. This heaping of loose materials, sand or gravel, evidently shows the prolonged action of the sea against its shores. Supposing that the Silurian ridge had been elevated before the formation of the coal, it would have necessarily served as a shore, and we should find somewhere a marked difference in the thickness of the transported materials abutting against it. No geologist has ever seen anything of the kind, and the conglomerates like some beds of coal and of sandstone, go thinning to the west with a constant and uniform decrease.

2. All the peat bogs are formed in basins, as also all the deposits of coal, and the outlines of these basins are of course generally broken and irregular. This fact is observable in the eastern and southern borders of the coal-fields. But on the sides of the coal-fields lying opposite each other along the great axis that separates them, the outline is well defined and unbroken.

3. In a basin where many beds of coal have been successively formed and separated by different strata, some of the upper coal beds must necessarily abut against the walls of the basin, when they are found in their horizontal position. In other words,

by the outward direction of the wall of a basin an upper bed ought to be extended somewhat beyond the lower and cover its margin. It is the case in the western borders of the Kentucky coal-fields, viz. in Christian county and other places, where the 4th coal above the conglomerate or the next bed below it, abuts against the older formation, when the lowest coal has to be looked for farther back towards the centre of the basin. On both the opposite sides of the Appalachian and the Illinois coal-fields, the appearances are different. It is the lowest coal, then the conglomerate, then the sub-carboniferous strata that appear one after the other upon the surface, following a dip corresponding to that of the sides. This undoubtedly shows that they participated in the movement which elevated the ridge that divides them, and that they were formed before its upheaval.

4. The undulations of the surface of the coal-fields, so distinctly marked in the vicinity of the Alleghany mountains that by lateral compression the veins of coal have been upraised in a perpendicular and even in a reversed position, are constantly repeated, though constantly less frequent and abrupt elevations westward. The upheaval of the Silurian ridge appears like one of those undulations, being generally in a direction parallel to the others.

5. The upheaval of the Alleghany mountains and the undulating movement caused by it upon an immense surface of country was very slow, and continued for a long period. The bends or flexures of the eastern coal, especially of the anthracite coal-fields are not jagged and angular, nor are they often broken by faults. The shales are polished by sliding, and rolled as if they had been folded in a soft state. The coal itself presents the same appearance, and at the bottom of the flexures, it is generally, as the miners well know, somewhat thicker than on the raised sides, as if the matter had slipped by its own weight when there was room for a displacement. Hence, it follows that if the undulating movement was slow, and if the strata of the coal measures were still in a soft state and easily removable, the top of the great ridge was necessarily and easily washed away as fast as it was being raised near and above the surface of the sea. No wonder therefore that the remains of the coal strata have not been preserved, and that we scarcely find any trace of them. The total disappearance of the coal washed away by erosion, is, I think, the only objection of any weight that has been or may be made against the opinion advanced in these remarks. But there are in Pennsylvania, in Ohio, and everywhere in the coal basins of the United States, evident traces of vast denudation that may be compared with the washing away of the Silurian ridge, and of which no trace has been left in the subsequent strata of this country.

It would be easy to multiply these considerations and to sustain the position by a number of geological facts. But so much is sufficient for our purpose, and we come back to the question of the formation of the coal. Upon the supposition then that at the time of the coal formations, the Appalachian and the Illinois coal-fields were united in one area, their surface would fairly be estimated at 300,000 square miles. Now, in the new theory presented above, we find it asserted: that the shales and the sandstone of the coal have been deposited upon the surface of the peat bogs of the coal formations by the inundations of some large river! Would it be possible for a sound mind to admit that a river can cover at once or even by repeated inundations, a surface of three hundred thousand square miles with a deposit of sand from six to one hundred feet thick, which is the thickness of the Mahoning sandstone.

Giving to the hypothesis the widest range of probability and considering as a peculiar Delta the area (sixty thousand miles) of the Appalachian coal-fields, still we find no geological phenomena of our time to justify it. Let us compare a few data. The whole plain of the Mississippi, comprising the Delta, from Cape Girardeau, 50 miles above the junction of the Ohio to the sea, covers an area of about 30,000 square miles. Would it be possible to suppose that an inundation would ever cover this whole surface with only a few feet of sand or of mud? According to the observations mentioned by Forshey, the mud transported in one year by the Mississippi river would cover a surface of twelve square miles with one foot of alluvium. At this rate it would take five thousand years for a river as mighty as the Mississippi to cover a single bed of the Appalachian coal-fields with one foot of shales.

Moreover, it is well known that a river cannot spread any of its transported material in a uniform manner, especially not in the deltas which are exposed to continual changes. For a delta is never composed of compact materials. It is mostly cut by variable and sometimes under currents covered only by a crust of vegetation, sustained by drift wood or floating upon the deep and muddy waters. These currents cause constant alterations: extensive marshes sink and are buried to a great depth below the general level of the country; lakes appear in some places and dry up in others; some bayous are filled and others opened. There are few square miles around New Orleans and on the Mississippi delta, that have not been thus subjected to violent disturbances, whose effects will be traced for ages in the most varied and disordered position of materials or stratification, if it can be so called. On the contrary, the stratification of the coal measures is of the most regular kind. The homogeneousness of the strata superimposed on the coal, especially the shales, shows

the total absence of a current at the time of the deposition of the matter. Not only the most delicate parts of the leaves of ferns are preserved in the shales, just as they fell from their supports; but we generally find around the same spot the remains of the same species. A kind of fern of which the deciduous leaflets are generally found separated from the stems (*Dictyopteris obliqua*, Bunb.), in some places completely covers the shales over a surface of from six to ten square feet, and without this space, not a single leaflet of the same species is found. It is evident therefore that the leaves have been buried at the place where the ferns grew and as they were falling from the stems. The slightest current would have made of all the matter a disordered mass in which leaves of every kind would have been mixed, not only in every position, but without regard to the place of their growth.

It is impossible to account for the successive deposits of shales and of sandstone by a river. When an inundation is at its height, it bears with it the heavier materials and these are deposited just as the current subsides. The sand would therefore be deposited before the mud or the sandstone formed below the shales and not above it.

But the deposits of all our great rivers, the Mississippi, the Ganges, the Amazon, the Po, is mud only. Sand is occasionally transported by a river or removed from one place to another by some strong current, but then it constitutes a bank and is generally a local formation of small extent.

All the great deposits of sand in our time, which by their thickness and extent, may give an idea of those which have covered the bogs of the period of the coal, are marine formations. The drift of North America and Northern Europe, our Pine-barrens of the south along the shores of the Atlantic; the pampas of South America, the heaths of Luneburg or sand plains along the southern shores of the Baltic Sea; the sand hills of Eastern Germany and Holland along the shores of the North Sea; the downs of the Gironde and of the Camargue in France; the sandy deserts of Syria, &c. No one of these formations can be referred to the direct agency of a river.

That the sandstone of the coal generally contains no remains of marine animals, does not prove that it is not of marine origin. The sand of our drift scarcely contains any of them. The hills of sand along the shores of the Baltic and the North Sea are almost entirely destitute of shells and animal remains. Sand is not only permeable to the all decomposing oxygen of the atmosphere, but it is a grinding agent, and as it is put in constant motion, either by the waves and currents of the sea, or by the wind, it is not to be supposed that even the shells would be long preserved in the loose materials. Yet in some places, the sandstone of the coal, especially when it is fine and soft, has

preserved the casts of marine shells, though not the remains. I have found them in many places, especially near Athens, Ohio, where a bank of soft sandstone is full of large *Producti* and *Terebratulæ*. But here, as in the sandstone of the lower measures, the animal remains have disappeared, and the mould only is preserved. It is the same with the prints of fossil wood found in the sandstone, which only shows the casts of Lepidodendra, Calamites, Sigillariæ, &c.; with only a thin lamina of carbonized bark, the whole substance of the wood having disappeared, except where silicification has taken place. This shows why the fossil remains are so rare in the sandstone, since even a cast can scarcely be made on loose sand.

In the shales of some beds of coal, especially in the southwestern part of our coal-fields, the remains of marine shells abound: some of the species are supposed to have lived in brackish water; but most of them like the fishes found in connection with them, appear to be true marine species. And what at first may look like an anomaly which will be explained hereafter, these marine remains are sometimes more or less mixed with leaves of ferns or land plants, and scarcely if ever with true marine plants or Fucoids. Thus, also, from palæontological evidence, the shales cannot be considered as deposits of a river any more than the sandstone.

The fact that the limestone of the coal measures cannot be thus disposed of, is fatal to this new theory. Its marine origin is evident and must be accounted for. And as the ocean cannot be swollen, like a river, it is necessasy to admit of a subsidence of the land for its submersion in the sea. But the supposition of a continual subsidence of a vast country is truly as violent an hypothesis as the supposition of an alternation of upheavals and subsidences of the same country, and the difficulty to account for the first proposition is far greater. Geological forces are not acting forever in the same way. It is now generally acknowledged that mountains have not been upraised in a single movement, but by a succession of gradual efforts, or by epochs of upheaval succeeded by epochs of rest, and consequently of subsidence; since a diminution in the activity of the internal forces cannot but cause a depression by the natural resistance or the weight of the upraised masses. We find proofs of such alternate changes of level at the present time; the movements of the ground about the temple of Serapis, so clearly explained by Lyell; the appearance and disappearance of some islands, &c., and especially in the stratification of our recent formations. The coal of the Miocene epoch was also formed by peat bogs upon an upraised land. The shales contain leaves of different species of trees of which the congeners are found in tropical regions. These shales are covered by successive strata of conglomerate, sand-

stone, and limestone. The coal and the lignite of the Pliocene epoch have been formed in the same way. Their shales contain remains of land plants, and sometimes also they are alternately covered by sandstone and limestone. The drift which is extended over the whole is as evident a marine formation as the limestone itself, and now it is in some places more than seven hundred feet above the level of the ocean. Is not this succession of land, freshwater and marine formations, in perfect accordance with the alternations of the strata of the coal measures, and can it be explained in any other manner than by the oscillation, the upheaval and subsidence of the land which supports these formations?

Even if the theory of continual subsidence could find in recent phenomena anything favorable to its support, it would be impossible to understand how a long protracted downward movement, especially of a Delta, would effect the repeated formation of coal beds; how the land being completely covered by the sea for the formation of the limestone, could be dried up again, so that the formation of the peat could begin anew, upon its whole surface. The river, says the theory, was still filling up again the whole space, while the madrepores were building the limestone. But this is pure speculation which is equally contrary to reason and to geological facts. For, if it is true that from causes which have not yet been clearly explained, the delta of the Missisippi is slowly subsiding, it is probable that if the subsidence was once active enough to permit the invasion of the sea over its whole surface, the soft matter, sand, mud and peat, of which it is composed, would be washed away by the marine currents, the tides, the waves, &c.

In the Report of the Geological Survey of Kentucky, I expressed an opinion which does not now perfectly satisfy my mind. I supposed that after the formation of extensive peat bogs, the subsidence of the land being at first very slow, the first result of the downward movement was a general inundation either of marine or of freshwater or of both mixed together. A depression of only a few feet of the great swamps of Southern Virginia would bring upon them by-and-by the waters of the surrounding rivers and also some water from the sea, either percolating through the sand or finding its way by some friths between the hills of sand extended along the shores. This supposition fully explains the formation of shales covered in some places with marine shells and remains of fishes mixed with land plants of the peat bogs. For, these plants, especially the ferns, mostly growing upon the thick and high rootstocks could still live in the swamps invaded by marine water. It explains also the local formation of the limestone in some depression of the marshes or marine lakes. But I supposed that after this period

of slow subsidence, the downward movement becoming more rapid, the sea broke through its sandy barriers and swept at once upon the whole plain, bringing with it the sand of its shores for the formation of the sandstone. I do not find this last supposition necessary. For, even with a slow movement of subsidence, continuous for a while, the sea ought to penetrate to the interior of the land, and with its continuous encroachments, bring forward with it the sand of its shores. This would better explain why some strata of coal and sandstone are thicker westward, where the bogs grew for a longer time and where the action of the sea was afterwards prolonged. It explains, also, why to the westward some veins of coal are double and generally more numerous than to the southeastern part of our coal-fields, this multiplication being caused by partial retrocession and advance of the marine element, which was felt only near the inside of the coal-fields and did not reach the deeper outside borders of the original basin. But there is no material difference between these explanations. In either case the repeated upheaval of the sea-covered land is supposed as a necessary condition of the formation of the peat; for this matter can grow only upon land where the water of the sea cannot reach.

To this last assertion which has not been contradicted, we can add the following: that peat never grows on swamps that are annually or periodically flooded by river water. Examining the swamps of the Mississippi, the theory says, that though covered annually by inundations, they are entirely untouched by river mud: that those favored spots are surrounded, particularly on the side next the river, by dense vegetation, which acting as a sieve, completely strains the mud from the water before it reaches the peat swamps. The water of these swamps is therefore pure, and pure peat has been deposited there for ages. Contrary to this authority, I must be permitted to say that during about thirty years of explorations in the peat bogs of Europe and of the United States, I have never seen the peat growing in places exposed to the inundations of a river. On this subject, there is better authority than my own. De Luc, in the beginning of this century, was the first to remark that along the banks of some rivers, the Elbe, for example, there were formed extensive beds of peat, which appeared to be lower than the water level of the river at the time of its inundations, and that nevertheless they were not covered by water, but by a peculiar vegetation which by its decomposition furnished the essential constituent of peat. In the prosecution of his researches, he observed that along these bogs the bed of the river was bordered by a natural embankment, which even in the highest rise of water prevented it from reaching the peat bogs. This damming up was fully explained by his remark: that at the time of the inundations and

when the water was most loaded with sediment, the heaviest particles of muddy matter were deposited all along on both sides of the river, just where the current began to lose its force; and that by this process, continued for a long period of years, a natural dam being built along some rivers, the marshes on both sides of it, and formerly inundated, were eventually put out of reach of the inundations. I have myself ascertained that the thin particles of sediment which were at first deposited upon the marshes, formed an essential preparation for the growth of the peat, viz. an impermeable basin, and that it was only when this basin was entirely isolated and protected against inundation that the plants of the peat bogs began to appear and the peat to grow. This process explains the formation of the fire-clay which underlies every bed of coal.

The true peat bogs of the Mississippi delta are mostly located on or near the old shores of some crooked bayou and surrounded on all sides by a kind of embankment. Thus they are free from the influence of river water which, though clear, would stop the growth of the peat, by destroying the peculiar vegetation of the bogs.

The action of the water in building its own banks along the principal bed of a river is beautifully exemplified in the United States, especially along the Mississippi and some of its tributaries. Both sides of the Minnesota river are thus bordered by extensive marshes which cover the bottom land to the base of the ridge of the prairies. In spring they are filled with water, while the banks of both sides of the narrow channel are mostly dry still high above water. It is then very difficult to cross those marshes from the river to the prairies or to land from a steamboat. Seen from the top of some hill near by, the Minnesota then appears like three different rivers running parallel and separated only by two narrow strips of land overgrown with trees. In the summer time, the marshes are mostly dry, overgrown with sedge and some willows; but no peat bogs have till now appeared in any part of their whole extent, because the separation from the river is not yet complete and because they are still exposed to annual inundations. In Minnesota, the peat bogs are found upon the prairies, near or around lakes without outlets, and on the banks of the upper Mississippi under the same circumstances as on the lower, viz. in such places as are beyond the reach of inundations. We may have occasion to extend these remarks farther when we come to consider the nature of the vegetation of the peat bogs.

In spring, at the time of our periodical inundations, the plants growing on the marshes of the Mississippi and along its shores are mostly lying flat upon the ground in a state of partial decomposition. The high canes only (Arundinaria) rise above water. And as they mostly bear their branches and leaves near

the top of the stems, or above water, these stems can not help much in the process of purifying the muddy water. Yet it is true that it becomes clear towards the interior of the marshes, but only as fast as the current becomes insensible or the water still.

Mr. Lyell has been quoted as authority for many assertions for which he can scarcely be held accountable, or at least for the conclusions which are drawn from them. Thus the *new* theory of the formation of the coal tries to find support in a geological assertion of the celebrated English author, an assertion that I do not recollect to have read in any of Lyell's works and which would truly show too much of ignorance of the palæontology and even of the strata of the coal measures. It is this: "In the sandstone of the coal formations, it is customary to find trunks of trees, but only trees, no small branches, leaves or tender parts. And these trunks are observed to be mostly pines, highland trees, while the trunks of the coal seams proper are Sigillariæ, Lepidodendra, Calamites, swamp trees, &c." From this, the new theory concludes: that the trunks are the remains of drift timber brought by the river from the high lands.—As if the sea could not and did not float timber as well as a river!

But it is not with the conclusion that we have to deal now, but with the assertion, erroneous in every point.

1. The trunks of trees are by far more rarely found in the sandstone of the coal than the small fragments of leaves, branches, &c. Some strata of sandstone, the Mahoning sandstone and others of the low coal measures, are sometimes entirely blackened by those small fragments of plants so bruised that it is scarcely possible to identify any species. This is not a local appearance; but it is observable in the whole extent of the coal-fields generally on the same stratum of sandstone. This shows a rapid movement of the sea, which sweeping with impetuosity upon the peat bogs of the coal, washed away part of the decomposed plants and peat bogs and mixed them with the sand.

2. Representative species of the Pine family have scarcely been found in the true coal measures. In the family of the *Cupressineæ* which has more than sixty species of fossil plants distributed in twenty genera, there is not a single species belonging to the coal epoch. In the family of the *Pines* which has at least one hundred and fifty fossil species known, distributed in twelve genera, there are only thirteen species which have been referred to the true coal measures. Two of these, *Peuce Hugeliana* Ung. and *Peuce australis* Ung., belong to uncertain formations of coal of Van Diemen and Vanguroë Islands. Of two other species, one, *Dadoxylum Beinertianum* (Endl.) belongs to the limestone (not to the sandstone of the transition epoch), the other *Dadoxylum Sternbergii* Endl. was wrongly ascribed to the coal and be-

longs to the Miocene of Haering in Tyrol. A fifth species, *Pinus anthracina* Ll. and Hutt., is a cone which was found in the *shales* of England. There are then only eight species of the pine family which have been found in England, in a bed of sandstone referred to the upper coal measures and described by Witham.

Admitting the position of this sandstone as true, though it is most remarkable that the remains of the Pine family should have been found in the coal measures of England only, there has been found in the sandstone of the coal measures 4 species of *Stigmaria*, 15 species of *Sigillaria*, 10 species of *Lepidodendron*, 3 of *Knorria*, 4 of *Halonia*, 6 of *Calamites*, 10 to 20 species of *Psaronius* and other stems. This would make at least 60 species outside of the Pine family for 8 in it. The same proportion would be true according to the number of specimens. In the state of Ohio, near Athens, there is perhaps the most extensive deposit of transported silicified trunks that it is possible to find anywhere. Of some thousand specimens that I have examined, all belong to the genera *Sigillaria* and *Psaronius*. A single specimen which is not yet determined has concentric circles, and may belong to the genus *Araucaria*.

From recent observations, it appears that the genus *Sigillaria* is related to the *Isoetes* of our time, a water plant. All the *Psaronii* are trunks of ferns and like the other genera quoted above, they all belong to the flora of the true coal formations, and are found in the shales also. Nevertheless, this does not put aside that part of the assertion: that some trees of the sandstone might have been transported from a dry land. It is a complicated question which may be examined at another time.

(*To be continued.*)

ART. IV.—*Some Remarks upon the use of the Microscope, as recently improved, in the investigation of the minute organization of Living Bodies;* by H. JAMES CLARK, of Cambridge, Mass.

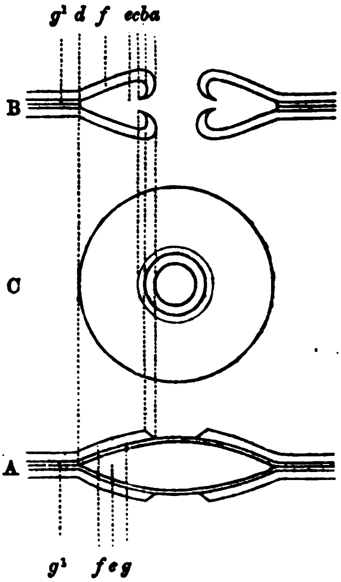
[From the Proceedings of the American Academy of Arts and Sciences, Boston, Mass., January 26, 1859.]

I WAS incited to bring together my thoughts and experiences upon this subject, by discovering, three or four months ago, a novel feature in the so-called glandular dots of the wood of our common White Pine (*Pinus Strobus*, Linn.).

A dot of this kind is usually represented by a circle (fig. 1, C, *d*), in the centre of which is a single or double ring (*a*, *b*), which has about one third the diameter of the first (*d*). The outer circle (*d*) is described as the boundary of a lenticular space (A, *e*) between two *contiguous cells*, and the inner double circle (C, *a*, *b*) as the outskirts of a perforation (A, *a b*) in the deposit layer (*f*)

of the cell. The double circle arises, as is said, from the fact that the perforation has the shape of an extremely short truncate cone, which, when viewed endwise, presents to the eye its two circular ends concentrically; the broader end, which is always next the interior of the cell, corresponding to the outer (*b*), and the narrower end to the inner circle (*a*). Thus are these dots described and illustrated, by Mohl, Schleiden, and Schacht, as seen in the common European Pine (*Pinus sylvestris*), and thus did they always appear to me, not only in that species, but also when I observed them in *Pinus Strobus*, except with this difference, that the perforation was bounded by an exceedingly faint third circle, (C, *c*,) whose relations I could not comprehend, nor was I able to reconcile its presence with the theory in regard to the nature of the perforation. I therefore left it, doubtingly supposing it to be some optical illusion. The microscope which I used, and which I have been in the habit of using up to within the last six months, is an Oberhaeuser's, made for Prof. Agassiz some years ago; and yet at this very day I find it as good, with perhaps a single exception, as any now made in Germany, and therefore just as trustworthy in the investigation of the glandular dots of the Pine.*

Fig. 1.



* It may not be uninteresting to state here, that the first great microscope made in Germany was constructed in 1829 by Fraunhofer, for Professor Agassiz. This microscope was represented in a copper-plate engraving, and described by Döllinger in the Memoirs of the Munich Academy for 1829, or 1830. In January, 1831, Agassiz went to Paris, and having given unlimited orders to Oberhaeuser for the best microscope that could be furnished, according to the knowledge of those times, he received from that maker, in 1832, an instrument which has not been surpassed in all Germany to this very day; at least, I have never seen any work from the hands of the best observers there, whether zoologists, histologists, physiologists, or botanists, which could not have been accomplished just as well by this microscope. There may be one exception to this of a very recent date, but I am acquainted with the instrument only through report. With this masterpiece of Oberhaeuser, Agassiz has gone on to this time, doing his great work with remarkable success, as all the world knows. Of late years it has become evident to Agassiz that his instrument was not equal to the demands which the progress of his researches put upon it; that there was something beyond its reach, of which he now and then could get a glimpse, just enough to warrant him in the belief that the study of the intimate structure of organized bodies had hardly begun.

So long ago as 1852 he had opportunities to see the workings of an instrument of the English pattern, made by Spencer; and although it was known as a rival of, if

For the last six months I have used one of the most recently improved microscopes, made by Mr. Charles A. Spencer of Canastota, N. Y.; and with this, between three and four months ago, I again attempted to solve the mystery of the glandular dots. This I did with the most complete success.

When the focus was brought to bear upon the inner surface of the dot, the innermost ring (B, C, *a*) of the perforation appeared first; a little deeper, the next outer one (*b*) came into view, whilst the innermost (*a*) disappeared; and still deeper the last (*b*) passed from my sight, and the faint ring (*c*) of my old observations came out sharply and clearly, as an exterior circle to the two others.

I also observed, when passing from the innermost circle (*a*) to the outermost (*c*), that the widening was gradual; and so, too, did it appear in the transit from the second ring (*b*) to the outermost (*c*). This gave me the clew to the whole structure. I saw that these rings were not the expression of a simple perforation, but of the outwardly curled edge of this aperture, shaped in such a way as to form a sort of trumpet mouth.

Although I would not trust to a transverse section alone, yet I found that it confirmed me in my views as explained above. The figures which I have given,—namely, a transverse section (B) with dotted lines projected upon a face view (C) of the dot, —I think will suffice to illustrate what I believe to be the true relations of these rings.

Now, why was it that the Oberhaeuser instrument would not divulge these relations, when the microscope of Spencer succeeded so satisfactorily? This I will explain by showing the difference between the objectives of the two microscopes. I will compare the action of the objective of Oberhaeuser to the manner

not superior to the Transatlantic microscopes, he did not become convinced that it came up to his requirements.

Two or three years later I had the pleasure of bringing to his notice the results of some of my own researches upon the value of recently constructed objectives of English make. This gave him renewed hope, and, having heard of Spencer's continued rivalship and growing superiority, he determined to test his skill to the utmost. He therefore, in 1857, requested me to visit Canastota, in order to consult Spencer, and advise him as to the nature of the work for which we wished to use his instruments. This consultation resulted in the conclusion that we must have three sets of objectives;—one with the extremely flat field; a second of the like kind, but so put together as to allow working with it plunged in water; and the third with a depthing focus extending as far as possible beyond that of the ordinary kind, for the purpose of viewing objects as a whole, in order to ascertain the relations of their different parts. And Spencer is now devoting those extraordinary abilities which show him to be a man of genius, to the construction of a microscope which shall embody not only the optical excellences of the different systems of lenses required for the various modes of investigation, but also those conveniences of mounting which the long use of that instrument has taught us, to facilitate the researches upon the living being in its normal condition, and in its element, that we may be no longer compelled to represent the tortured figures of a crushed body or dismembered organism.

in which a plano-convex lens treats the rays of light which pass through it, from any object. Those rays which pass near its axis are brought to a focus at the farthermost possible point from the lens, whilst the rays which pass through the periphery are converged at a much nearer point, and between the axis and periphery there are all degrees of convergence. The difference between the farthermost and nearest points of convergence may represent the distance or depth through which the objective takes cognizance of things, and will account for the fact that I saw all the rings of the Pine-dot at one time.

The action of the objective of Spencer's microscope may be compared to that of a parabolic lens, which converges all the rays of light to one absolute plane, and therefore forms what is called a *flat field.*

Now out of this field, either above or below its horizon, it is not possible to see anything, and on this account, when the innermost ring (B, C, *a*) of the dot was in view, the others were not to be observed; and when the field was lowered to the second ring (*b*), the innermost one (*a*), being above the horizon of the field, was invisible; and, again, when the outermost and lowest ring (*c*) was reached, the middle one (*b*) also vanished.

Were this outermost ring as distinct as the others, it might have been possible to detect its relations by means of the Oberhaeuser; but since it is the exceedingly delicate, reverted edge of the perforation, the narrow aperture of this ordinary objective does not admit sufficiently oblique rays to define it, to say nothing of its being confused with the other rings which are in view at the same time.

I would here remark that this peculiar structure is most frequently to be observed in old wood, when the cell-wall (B, g^1) has also become perforated, and even has retreated from the deposit layer as far back as the edge of the lenticular interspace. In young wood the perforation corresponds with the figures usually given. I have used this discovery, not only to show how little may be understood of the structure of a familiar and much treated of body, but also as a preliminary illustration of the exceeding value of a flat field and a wide angle of aperture in microscopic investigations.

But this is not the first example which has occurred to me. As far back as a year ago last summer I visited Mr. Spencer, and spent several days with him in testing his objectives with the tissues of every creature which we could find. I shall never forget the astonishment and delight with which I occupied day after day, plunged into the hitherto unknown depths of organic life. I say this after having tested from time to time some of the best English microscopes which have been made since the "Great Exhibition," and therefore am not to be supposed to

ıve made so great a leap as if from an Oberhaeuser to a Spencer. nce that visit, and another one also, made last summer, when obtained one of Mr. Spencer's quarter-inch objectives, with an ıgular aperture of one hundred and forty-five degrees, I have om time to time made particular efforts to test the value of the ıt field and wide angle in the study of organized bodies. The sults of my investigations at Canastota, and also since my turn, I have embodied in this paper.

One of the most valuable properties of the flat field is, that it ıables one to study an isolated cell, in a manner totally unexected to me, making it possible to obtain a section of such a ıdy at any horizon, as if it were actually cut across. As I have id before, the flat field ignores everything above and below its rizon, and therefore, if it is brought on a level with the equar of a spherical cell, the largest possible circle is obtained, and ıe actual thickness of the wall becomes apparent; and if it is ised or lowered, the circle grows smaller and the wall seems ıicker, because of the obliquity of the section, and yet appears ı distinct as the one at the equator. This may go on until the eld approaches very closely to the upper or lower side, and then ıe inner surface of the cell appears. In an ordinary microscope, ıe far-reaching power of the objective utterly precludes the ssibility of such a process of investigation.

The relations of the Purkinjean vesicle to the yolk, and the umber and position of the Wagnerian vesicles, have always een difficult subjects to work out with the ordinary microscope. f the Wagnerian vesicle was situated at the upper or lower side f the Purkinjean vesicle, it has often been next to impossible ı tell whether it might be really within the latter, or was one f the very similar yolk-cells outside. There are many other ıstances of the like kind too numerous to mention. All this ifficulty I have seen obviated by the decided, section-like preision of the flat field, which at once revealed to the eye the xact and relative level of every vesicle or yolk-cell.

I was most forcibly reminded, not long ago, of the value of ıe wide angle of aperture, and the accompanying great amount f light, upon trying Spencer's objective upon the stem of a vell-known Hydroid, the *Clava leptostyla*, Ag. In the manucript of the forthcoming volume of Professor Agassiz's "Conributions to the Natural History of the United States of Amerca," the outer wall of this Hydroid, and of several others, I ıay say in passing, had been described as a structureless memrane; but what was my surprise, in my last attempt, to find hat this wall was composed of a layer of polygonal cells, as listinct as any in the other parts of the animal, and even readily liscernible in the more opaque parts, where the stem appeared ike a simple black surface under the ordinary microscope.

In regard to the usually estimated worth of wide angles of aperture, I would say, that, from numerous experiments upon living tissues, objectives having this property are valuable, not so much because they can admit extremely oblique one-sided rays, but because they allow rays to enter from all sides at a very wide angle to the axis. One-sided oblique rays throw the shadow in a great measure, beyond any particular cell upon its neighbor, and this produces distortion; whereas when the rays converge at a wide angle, each cell becomes strongly marked at its periphery by a dark, broad shade. A moderately oblique, one-sided light, hardly twenty degrees from the axis of the objective, always appeared to be the most frequently serviceable. I was surprised one day to find that the hitherto faintly visible circulation in the cells of Spirogyra was rendered, by such a light, very distinct, and the granules borne along in the current appeared like little specks with a very sharp, thick, black outline.

At first thought, there would appear to be an insuperable objection to the wide angle of such objectives, and that is the shortness of the working distance, which will not allow one to take anything more than a superficial view of a body, even of moderate thickness. But this objection has not the least force, and, on the contrary, the more nearly absolutely flat the field is, especially in the lower powers, such as the $\frac{1}{2}$, $\frac{3}{8}$, and 1 inch, the better will they bear the use of the higher eye-picces. This is not a speculative suggestion, for I have been told by Mr. Spencer, that he has been able to see the lines upon *Pleurosigma angulata*, with a one-inch objective of his make. Now nothing but the enormously wide angle and the remarkably flat field which he has introduced in such a low power, could enable one to solve such a finely marked Diatom. Only a few years ago this little unicellular plant was a test object for the highest powers of the best microscopes.

But if this image, or the image of any minute body, is to be magnified to any extent which may be required, by the use of the higher eye-pieces, the latter must be most exquisitely corrected, as regards their spherical and chromatic aberration, or else everything comes to the eye in a distorted state. On this account the Huyghenian ocular is not fit to be used, since it lacks just what we need here. I have for several years past asserted that the next step in the increase of the magnifying powers of the microscope would be accomplished by the construction of a new form of eye-piece, which would augment the image formed by the objective to an almost unlimited extent. At last I am happy to find my prediction verified, in the most practical manner, by the "orthoscopic ocular" invented by Spencer. With such a range of powers, then, there is hardly any body of moderate transparency, but what may be minutely investigated to its

sore. If a subject is too thick for the short working dis-
of the higher powers, a lower objective may be used, and
gher oculars applied to make up the deficiency. Of course
iot mean to say that a certain amplification obtained by a
bjective and a high orthoscopic ocular is fully as good as
ume afforded by a higher objective; but in case the latter
t reach a certain internal structure, the former can be used,
very little appreciable difference, and is by far better than
sual methods employed in such cases, such as pressure or
tions and the isolation of the organ to be investigated.
ave not had an opportunity to make frequent use of the
oscopic eye-piece;" but Mr. Spencer has furnished me with
er form of ocular, the "solid eye-piece," invented by his
Mr. Tolls. This, Mr. Spencer tells me, so closely ap-
ies the "orthoscopic eye-piece" in quality, that none but
r experienced eye could detect the difference, and the for-
xcels the latter in the admission of light, because it has
reflecting surfaces. With this ocular and a quarter-inch
ive I have run the magnifying power up to two thousand
ters, with wonderful results which fully justify me in say-
l that I have in regard to the study of thick tissues with
owers having wide angles of aperture.*
ill take a young fish as an example to illustrate the re-
ible efficiency of the flat field. In a view from above, one
ee no less than six or seven different layers or sets of
s resting one over the other; first the skin and the muscu-
'er, next the vertebræ, within these the spinal marrow, and
the latter the chorda dorsalis, and close to this the dorsal
, then the intestines and their appendages; and yet every
f these may be plunged through and totally ignored, on
at of the peculiar properties of the flat field, and the last,
testines, minutely inspected, not only cell by cell, but each
iay be studied, in every particular of detail, as if it were
d. And so may any set of organs be treated, whether
ed above or below in the animal. With such means at
as long as cells may be seen with a very moderate light,
itterly preposterous to trust what may be worked out by
ting these organs from the animal, piecemeal. When in-
very cell may be measured, not only transversely, but also
the greatest nicety in a perpendicular direction, by the

this connection I would urge upon students the necessity of avoiding the
owers of the microscope in the commencement of their studies. When
re learned to use the lower objectives, it will be a much easier matter to
the higher ones. Students usually suppose that they can see everything
s higher powers, whereas they are greatly mistaken; as much as one would
should make a minute inspection of the stones of some great architectural
l then think he had obtained a proper conception of its magnificent plan
ious proportions.

micrometer screw, which works the fine adjustment of the objective; every cell, indeed, may be treated as if it were a separate body; but who would warrant to measure, for instance, the size of the cells of a nerve after it had been removed from its natural position, and with more or less inevitable distortion? Unfortunately, investigators have been compelled to do this too often, up to this very day; but now I hope for much better and more trustworthy results.

In embryology, how beautifully this almost transcendental definition of the objective applies! All the cells of an embryo of a certain age may be represented by a circle, with a smaller circle within known as the mesoblast (nucleus). At successively later ages we find the cells of the nerves, for instance, simply oval, as the first step to elongation; next they are in rows; then the ends in contact are without walls, so that each cell opens into its neighbor; and finally, all trace of the separate cell-wall is lost in the straight sides of the nerve tubule, with nothing but the mesoblasts to indicate the original position of the cells. In the chorda dorsalis, intestines, vertebræ, muscles, &c., similar and apparently gradual changes have been observed; but each step, in most instances, was investigated isolately from the previous one, and the intervening space bridged over by the process of inductive reasoning alone. This is not enough; now we know that every second of the life of a cell, or series of cells, may be traced most minutely, minute by minute, hour by hour, and day by day. Day and night, watches have been kept by observers in other departments of science, and why may not the naturalist do so? In some cases a very extensive series of changes may be observed in a short time; for instance, in the embryo of the common Bream (*Pomotis vulgaris*), which Prof. Wyman has observed to pass from the segmenting of the yolk to hatching in the space of about forty hours. It is not possible, in any way, to trace the gradual metamorphoses of cells and organs, except upon the living body; otherwise, every observation is a record of a detached fact, and no more; every bit of an organ is subjected to all sorts of manipulations to bring out what too often is not there according to the laws of the living being. Reagents at one time, and pressure at another, reveal, not the truths of nature, but our carelessness and presumption. I have in mind a remarkable instance of the evils of the almost monomaniacal habit of using pressure whilst investigating tissues. A celebrated physiologist, in all probability, missed the most fortunate chance of discovering the key to the whole history of the mode of origin of the embryo from the yolk-cells, simply by using a bit of thin glass to cover the object on his glass slide. Just before the segmentation of the yolk, the full-grown yolk-cells of birds, turtles, if not of all scaly reptiles, and

sharks, are very thin-walled, hyaline, globular vesicles, each one of which contains a more or less darkened mesoblast, and within the latter are a certain number of entoblasts (nucleoli). Now under the least pressure, the cell-wall bursts quickly, and the mesoblast becomes fissured or wrinkled. In this condition the mesoblast was figured and described as the yolk-cell proper, by no less careful an observer than Johannes Müller. Now in the turtle, at least, the mesoblast undergoes self-division until there are innumerable mesoblasts in the parent cells; and after the latter have congregated to form the different layers of the incipient organs of the embryo, and burst, the former unite side by side, and thus become the original cells of the young tissues.

I feel that I cannot urge too strongly the utmost necessity of studying living beings as nearly in a state of nature as is possible; to attempt this by all available means and contrivances, and, above all, patiently, not begrudging the time, because more numerous observations might be obtained by making a piecemeal and hurried show of dismembered Nature.

It would certainly be more profitable as far as living beings are concerned, if the whole world of science should, for a while at least, investigate exclusively the few transparent animals that may be obtained, than work over the numberless opaque ones which require the dissecting-knife. The first having been investigated, the knowledge of them would assist us the better to interpret the features and relations of the tissues, which we would be obliged to study in a disconnected state, just as fossils are recognized and restored by the comparative anatomist after a careful research among living models.

I have been anxious to present this communication, and to have it recorded, because certain microscopists, who are considered as high authority both in England and in this country, have attempted to depreciate the value of the flat field and wide angle of aperture in the study of living objects. This is a little remarkable, since it comes from a country where, until recently, the most finished microscopes of this kind were made, and where they are now to be found in large numbers. I will read a few passages, which may be found on page 196 of Dr. Carpenter's work on the microscope. He says:

"The author feels it the more important that he should express himself clearly and strongly on this subject, as there is a great tendency at present, both among amateur microscopists and among opticians, to look at the attainment of that 'resolving power' which is given by angular aperture, as the one thing needful; those other attributes which are of far more importance in almost every kind of scientific investigation, being comparatively little thought of; and he therefore ventures here to repeat the remarks he made upon this subject, in his recent Presidential address to the Microscopical Society, of the correctness of which he has been

since assured, by the approval of many of those who have most successfully employed the microscope in physiological investigations: 'The superiority in resolving power possessed by object-glasses of large angular aperture is obtained at the expense of other advantages. For even granting that there is no sacrifice of that most important element, *defining* power (which can only be secured, with a very wide angle, by the utmost perfection in all the corrections), yet the adequate performance of such a lens can only be secured by the greatest exactness in the adjustments. Only that portion of the object which is *precisely* in focus can be seen with an approach to distinctness, everything that is in the least degree out of it being imbedded (so to speak) in a thick fog; it is requisite, too, that the adjustment for the thickness of the glass that covers the object, should exactly neutralize the effect of its refraction; and the arrangement of the mirror and condenser must be such as to give to the object the best possible illumination. If there be any failure in these conditions, the performance of a lens of very wide angular aperture is *very much inferior* to that of a lens of moderate aperture; and, except in very experienced hands, this is likely to be generally the case. Now to the working microscopist, unless he be studying the particular classes of objects which expressly require this condition, it is a source of great inconvenience and loss of time to be obliged to be continually making these adjustments; and a lens, which, when adjusted for a thickness of glass of $\frac{1}{100}''$, will perform without much sensible deterioration with a thickness either of $\frac{1}{80}''$ or of $\frac{1}{120}''$, is practically the best for all ordinary purposes. Moreover, a lens of moderate aperture has this very great advantage, that the parts of the object which are less perfectly in focus can be much better seen; and therefore that the relation of that which is most distinctly discerned, to all the rest of the object, is rendered far more apparent. Let me remind you, further, that almost all the great achievements of microscopic research have been made by the instrumentality of such objectives as I am recommending. There can be no question about the large proportion of the results which continental microscopists may claim, in nearly all departments of minute anatomical, physiological, botanical, or zoological investigations, since the introduction of this invaluable auxiliary; and it is well known that the great majority of their instruments are of extremely simple construction, and that their objectives are generally of very moderate angular aperture. Moreover, if we look at the date of some of the principal contributions which this country has furnished to the common stock,—such as the 'Odontography' of Professor Owen, the 'Researches into the Structure of Shell' carried out by Mr. Bowerbank and myself, the 'Physiological Anatomy' of Messrs. Todd and Bowman, the first volume of the 'Histological Catologue' by Prof. Quekett, and the 'British Desmideæ' of Mr. Ralfs,—we find sure reason to conclude that these researches *must* have been made with the instrumentality of lenses, which would in the present day be regarded as of very limited capacity.—I hope that, in these remarks, I shall not be understood as in any way desirous to damp the zeal of those who are applying themselves to the perfectionizing of achromatic objectives. I regard it as a fortunate thing for the progress of science, that there are individuals whose tastes lead them to the adoption of this pursuit; who

stimulate our instrument makers to go on from one range to another, until they have conquered the difficulties which previously baffled them; and then apply themselves to find out some new tests, which shall offer a fresh difficulty to be overcome. But it is not the *only*, nor can I regard it as the *chief* work of the microscope, to resolve the markings upon the Diatomaceæ, or tests of the like difficulty; and although I *should* consider this as the highest object of ambition to our makers, if the performances of such lenses with test-objects were any fair measure of their general utility, yet as I think that I have demonstrated that the very conditions of their construction render them inferior in this respect for the purposes of ordinary microscopic research, I would much rather hold out the reward of high appreciation (*we* have no other to give) to him who should produce the *best working microscope*, adapted to all ordinary requirements, *at the lowest cost.*"

Notwithstanding the approval of those, as Dr. Carpenter says, "who have most successfully employed the microscope in physiological investigations," I do not hesitate for a moment to declare, that nothing could be more pernicious to the best interests of science than these remarks. It is unfortunate that such mistaken views should be displayed on this subject, where so great confidence has been placed,—by one, too, whose elementary works on physiology have raised the belief, among many, that he is perfectly conversant with those very tissues which require the nicest and most rigid microscopical investigation.

The illustrations which I have given of the great value of highly corrected lenses in the study of minute structures, are sufficient, I think, to refute these views; but I would like to say a few words more in conclusion, especially in reference to the general relations of microscopical investigations to other departments of natural history.

To say that objectives with a wide angle of aperture and a flat field, are needed for only a few bodies, such as test-objects, like the Diatomaceæ and other known difficult subjects, is to ignore the whole great department of histology, and by that to refuse physiology one of the most important aids; in fact, an aid which, with the help of better microscopes, in future, is likely to take the lead in the determination of the laws of animal and vegetable life. I am well aware that the study of histology has been pursued with the ordinary instruments, of the German pattern, in a great measure; but knowing what these have done both in Europe and in this country, and having discovered, by a few glimpses, how much more, and how much better, we might have done, had we possessed one of these highly finished instruments, I can confidently assert, that it is a grave error to tell opticians they had better devote themselves more particularly to the improvement of the ordinary instruments, and let their transcendental corrections of widely gaping objectives serve in the mean while as playthings for curious amateurs.

But it is a still more serious mistake to say to students, that an instrument which performs under a variety of circumstances "without much sensible deterioration" is practically the best for all ordinary purposes.

So thought Ehrenberg, and yet we all now know what curious mistakes he made. Embryology, too, comes under this proscription; for any one who has attempted to trace the development of animals, especially the lower forms of life, must know that it is impossible to separate the study of their cellular structure from the investigation of their organs.

I cannot more fittingly conclude this communication, than by quoting, by Mr. Spencer's leave, a portion of a recent letter of his to me. He says: "It seems to me that there is every reason to hope much from the earnest application of high powers with large angles. So blind and inveterate has been the prejudice in favor of low powers and small angles, in histology, that younger and less prejudiced microscopists have a comparatively untrodden path before them. Every day's thought convinces me more and more deeply of the radical mistake that has been made in this direction. I have recently been making some observations and experiments with low angles on certain well-known structures, and have in several instances been struck with a blank astonishment at the utterly false, though apparently reliable, results obtained. It happens, too, that the physical and optical characters of those tissues which, oftener than any others, are the subjects of your study, are precisely such as will lead to the most frequent errors; and if you do not find that many a blunder has been made in their study, heretofore, I shall be greatly surprised."

ART. V.—*On Brewsterite;* by J. W. MALLET.

Two analyses of the mineral species Brewsterite are on record, those of Connell* and Thomson,† both made many years ago. The results were:

	Connell.	Thomson.
Silica,	53·666	53·045
Alumina,	17·492	16·540
Baryta,	6·749	6·050
Strontia,	8·325	9·005
Lime,	1·346	·800
Water,	12·584	14·735
Peroxyd of iron,	·292	.....
	100·454	100·175

* Edinb. N. Phil. Jour., No. XIX, p. 35.
† Outlines of Mineral. Geol. and Min. Anal., vol. i, p. 348.

It is strange that in Thomson's Outlines of Min., Geol., &c., the analysis of Connell is given with altogether different figures—thus:

Silica,	52·400
Alumina,	15·918
Baryta,	5·827
Strontia,	7·709
Lime,	1·007
Water,	·208
Peroxyd iron,	12·584
	95·653

Dr. Thomson remarking at the bottom of the page that the specimen analyzed by himself consisted of fine crystals carefully selected, while that examined by Mr. Connell was a mixture of amorphous and crystallized mineral.

The method for the separation of baryta, strontia, and lime, employed by Connell—probably by both analysts—namely, the solution of nitrate of lime and afterwards of chlorid of strontium, in alcohol—has given place to more reliable processes, and on this account a repetition of the analysis might be desirable; but it becomes still more so when the close analogy of brewsterite to heulandite is considered. The two species should in all probability have the same general formula, and this has in fact been assigned to them in Dana's Mineralogy, but with the formula for heulandite these older analyses of brewsterite do not very well agree.

I have recently analyzed some fine specimens, from the original locality—Strontian in Argyleshire, Scotland—and the results appear fully to establish the chemical as well as crystallographic relationship with heulandite.

The mineral formed crusts of minute crystals upon the surface of gneiss: sometimes these crusts could be detached from the rock by careful blows, but in general they adhered very firmly. Some of the crystals were an eighth of an inch in length—most of them were much smaller. The following measurements were obtained—using the lettering of Dana.

$O : \frac{1}{5}\text{-}\bar{i} = 175° \ 49'—175° \ 53'—175° \ 55'$

$\frac{1}{5}\text{-}\bar{i} : \frac{1}{5}\text{-}\bar{i} = 171° \ 43'—171° \ 40'.$

$I : I = 136° \ 18'.$

$O : 1\text{-}\bar{i}\ (?) = 157° \ 23'—157° \ 17'—157° \ 20'—157° \ 22'.$

$I : i\text{-}\bar{i} = 112° \ 13'—112° \ 17'—112° \ 12'.$

The spec. grav. was found = 2·453.

For analysis the crystals were carefully broken off, and picked clean from any dust of the accompanying rock. In one case, the mineral was fluxed with carbonate of soda, so as to ensure perfect decomposition, and consequent purity of the silicic acid

weighed; the other specimens were treated directly with hydrochloric acid, which seems of itself to be capable of effecting complete decomposition. The baryta was precipitated by hydrofluosilicic acid,* and the relative amounts of lime and strontia were determined indirectly, by weighing the mixed earths first as sulphates and then as carbonates.

The following are the results obtained—

	(1)	(2)	(3)	(4)	(5)	Mean.		Atoms.
Silica, - -	54·49	53·66	54·31	54·84	....	54·42	1·209	4·08
Alumina, - -	15·42	15·29	15·05	....	....	15·25	·296	1·
Peroxyd of iron,	*trace*	·08	*trace*	....	....	....	....	
Baryta, - -	6·76	6·84	....	....	....	6·80	·089	·304—1·03
Strontia, - -	8·79	9·20	....	....	....	8·99	·173	
Lime, - -	·92	1·46	....	....	....	1·19	·042	
Water, - -	13·39	....	....	....	13·06	13·22	1·469	4·96
	99·67					99·87		

Analysis (4) was spoiled by an accident; and in (3) the determination of the earths was abandoned on ascertaining the necessity for the removal of ammoniacal salts before precipitating baryta (vid. note), a precaution which had not been taken in this case.

The silicic acid, alumina, protoxyds and water are clearly present in the ratio 4 : 1 : 1 : 5, giving the formula

$$(BaO, SrO, CaO), SiO_3 + Al_2O_3, 3SiO_3 + 5HO.$$

The atomic relation between the lime, baryta and strontia is near 1 : 2 : 4.

* In examining the precautions incident to this mode of determining baryta in the presence of strontia or lime, I have found no notice taken in any work on chemical analysis of the solvent effect of ammoniacal salts upon silico-fluorid of barium.

Fresenius states that the latter dissolves in 3400 to 3800 parts of water, and in 640 to 733 parts of water acidified by hydrochloric acid, but does not mention salts of ammonia.

I digested pure silico-fluorid of barium in the cold, with frequent stirring, for forty-eight hours—(*a*) with a saturated solution of chlorid of ammonium, (*b*) with the same solution diluted with twice its volume of water. The fluid was in each case filtered off perfectly clear, 100 cubic centimetres were measured, and the baryta was determined as sulphate.

(*a*) gave ·1942 grm. of $BaO, SO_3 =$ ·2338 grm. of $BaF, Si F_2$. Hence 1 part of the latter salt dissolves in 428 parts of a saturated solution of sal-ammoniac.

(*b*) gave ·1409 grm. of $BaO, SO_3 =$ ·1697 grm. of $BaF, Si F_2$, or 1 part in 589 of the diluted solution.

The necessity of removing ammoniacal salts from a fluid in which baryta is to be determined as silico-fluorid is sufficiently obvious.

Art. VI.—*On the importance of more frequent and more accurate Deep-sea Soundings in connection with the successful establishment of a Submarine Telegraph across the Atlantic;* by Prof. W. P. Trowbridge, Assistant U. S. Coast Survey.

In the year 1849, two citizens of Philadelphia, Horatio Hubbell, Esq., and Col. John H. Sherbourne, presented a lengthy memorial to Congress promulgating a plan for establishing telegraphic communication across the Atlantic ocean; and asking the Government to aid in carrying out the project. This memorial contained the announcement of the probable existence of a table-land or plateau between Newfoundland and Ireland, in the following words.

"Your memorialists proceed to say that from many observations which have been made, there is incontestible evidence of the existence of a submarine table land extending from the banks of Newfoundland across the Atlantic ocean to the mouth of the British Channel." "This is proved by the altered color of the sea water, which has a different appearance, in unfathomable places, from what it has in shallow spots." "This combined with the volcanic construction of Iceland and the Azores, and the situation of that portion of the ocean that lies between these volcanic groups, has led to the conclusion that there has been a lifting up of the bottom of the sea, through the agency of a Plutonic power, and that the bottom thus elevated appears to be cut through, in many places, by deep-water channels." "The appearance of Medusæ, Polypi, and other marine creations, seen upon the edge of the discolored water, strengthens this opinion." "Your memorialists propose that these suggestions should be investigated," &c.

The first experiments made to test the truth of these suggestions were the soundings of Commander Berryman, made in the summer of 1853. Previous to this time no cast of the deep-sea lead had ever been made north of the Azores. The soundings of Berryman, and the subsequent soundings of Commander Dayman, have been variously interpreted concerning the proof of the existence of the submarine table-land announced by Messrs. Hubbell and Sherbourne. In a popular sense this announcement conveyed the idea of a vast unbroken level at the bottom of the sea, the existence of which has not been conclusively established by the soundings referred to.

The question, however, is one of very little importance, provided the irregularities of the bottom do not offer any serious obstacle to the safe descent of an electric cable, or cause its destruction subsequently. The question now presented is, taking the bottom of the ocean as it probably exists, with elevations and

depressions corresponding to those found upon the face of the dry land, what influence will these elevations have upon the practical operation of depositing an electric cable, and in the preservation of the electric continuity. Upon this point there has been very little discussion, on account of the popular belief in the existence of a level bottom across the only part of the ocean where a submarine telegraph has been supposed to be practicable. But even upon the line of the Atlantic telegraph, although there may not exist remarkable submarine mountains and valleys, yet it is not improbable that considerable elevations and depressions occur. The profile of Capt. Dayman differed essentially from that of Commander Berryman; so much so as to give rise to serious controversies with regard to the strict correctness of both, since to the probable uncertainties of the soundings, was added the uncertainties in relation to the intermediate depths, the soundings being made generally fifty to one hundred miles apart.

The explorations of Dayman and Berryman ought therefore to be regarded as general reconnoissances only, from which the true profile of the bottom can only be conjectured. In the explorations of the Gulf Stream by the U. S. Coast Survey, Lieutenants Craven and Maffitt discovered, off Charleston, a series of submarine ridges and depressions several hundred fathoms in height and depth in the horizontal distance of twenty to thirty miles. Such ridges and valleys would have been passed unnoticed in the explorations between Newfoundland and Ireland.

It may be taken for granted that a submarine cable should touch the bottom at every point; otherwise some parts of it must remain suspended across valleys, or chasms, of unknown depth and extent; under these circumstances its continuity is endangered by its weight, its chafing at the points of suspension, the action of currents, and other causes. Whether the Atlantic cable was destroyed by such influences or not will probably never be revealed, but it may be important to examine how far a more accurate and detailed section of the bottom may diminish the risks which must always attend an enterprise of this character.

Such ridges and elevations as were found in the Gulf Stream, though moderate in height and depth when compared with the great depths of the Atlantic, are yet of sufficient magnitude to be taken into account.

The facility with which the ocean is traversed upon its level surface, and its great horizontal extent, compared with its depth, are apt to give rise to inadequate conceptions of the real magnitude of the inequalities of the bottom,—inequalities which upon dry land would be overcome with difficulty. But when it

is intended to adapt a line to these inequalities, it is their real and not their comparative magnitudes which must be taken into account.

An accurate and detailed profile of the bottom is therefore necessary in order to estimate correctly the total amount of cable required to reach from one point to another, following the curve of the bottom, This is importont, not only in determining the total depth of cable necessary to reach from continent to continent, but also to shew at what points a greater or less surplus over the horizontal extent is needed.

It is only by the aid of accurate knowledge upon these points that the practical operation of depositing a cable can be reduced to a positive degree of safety and certainty. It was shown in a paper communicated to the American Association for the Advancement of Science at the Baltimore meeting, April, 1858, that in laying a submarine cable, *if the rate of paying out be equal to the speed of the ship, and if the speed of the ship be greater than the rate of descent of the cable in the water, the form assumed by the cable from the ship to the bottom will be a right line*, and there will be no tension upon the cable, *provided* the bottom be a uniform level plain. But if, from depositing upon a level bottom, a descending slope be reached, the cable from the ship to the bottom will form a large catenary, one end of the catenary being at the ship and the other at the crest of the descending slope.

The catenary will produce a dangerous tension upon the cable, if the descent of the slope at the bottom be very deep, unless the speed of the ship be slackened.

The failure of the first attempt to lay the Atlantic cable off the coast of Ireland was doubtless due to this cause. The bottom suddenly fell off from five hundred fathoms to seventeen hundred fathoms, a descent of seven thousand feet, and the same speed being kept up, with nearly the same rate of delivery, it was impossible for the cable to assume the form of the bottom, and a catenary of large dimensions must have been formed, causing the great tension which parted the cable. The same circumstances must occur on a smaller scale when the depression is more moderate, even in deep water: and it may happen that a submarine valley is passed before the cable has had time to descend to the crests; in which case, if the surplus paid out between the crests be insufficient, there must inevitably be a catenary formed from one crest to the other, the effect of which cannot be avoided or foreseen.

It may therefore be safely asserted, that to avoid risk of breaking a cable in the operation of depositing it upon the bottom of the sea, *the speed of the ship should be regulated by the depth and form of the bottom.* If the principle be adopted of paying out a uniform surplus to suit all the inequalities of the bottom, there

will not only be an unnecessary waste of cable in some places, but the surplus may fail to be sufficient in others, the result of which might be a rupture.

On the other hand, provided an accurate and detailed profile of the bottom be constructed, from which the exact length of cable required between any two points, however near together, can be determined, there is no reason why an irregular form of bottom should present any serious obstacle to the safe deposit of a cable, provided the speed of the ship be so regulated as to deposit the proper amount in the proper place; and it is only by following this rule that risk of breaking from the weight of the cable can be avoided.

In conclusion, the following rules may be stated.

1. Soundings of unquestionable accuracy should be made at intervals not greater than ten miles, and where there is a steep slope of the bottom, at more frequent intervals.

2. From these soundings a profile of the bottom should be made, in sections, upon a large scale, from which the length of the curve of the bottom may be calculated.

3. A chart should be constructed based upon the profile, showing the rate of speed and delivery between the different stations, in order that the cable paid out may adapt itself without tension to the curve of the bottom.

4. The profile and chart should be used as guides in the operation of laying the cable.

There is a popular belief that many parts of the Atlantic across which submarine lines of telegraph have been projected, are filled with mountains and valleys of vast magnitude. All that can be said on this subject is, that the reported measurements of great depths are neither sufficiently accurate or numerous to lead to any probable conjecture of the natural features of the bottom. And the needle-like elevations which have been represented to exist, are more the result of imagination than a representation of facts. Whatever the form of the bottom may be, an accurate profile of it is the only true basis upon which any reliable calculations with regard to the practicability of a submarine telegraph can be made.

And with the help of such accurate profiles even where great irregularities of bottom exist, the risks of failure may not be so great as has generally been supposed. And it is not improbable that the Azores might be made an intermediate station between the two continents notwithstanding the supposed rugged character of the bottom near them; while there is yet no *proof* that the bottom between the Azores and the Banks of Newfoundland is at all unfavorable to such a project.

Art. VII.—*Abstract of a paper on the Ophiurans, a tribe of Star-fishes;* by Dr. Chr. F. Lütken.*

Terminology and Morphology.

The body of an Ophiuran consists of a disc, and five or six† arms issuing therefrom. The disc contains the digestive and reproductive organs and their outward openings, namely: the mouth with its five slits (*rimae oris*) forming a star in the centre, and twenty (in *Ophioderma*, &c.) or ten (in *Ophiocoma*, &c.) genital slits, on the under surface, parallel with and close to the arms. The arms have a solid frame and are supplied with nerves, vessels and muscles, and, by reason of their length and flexibility, acquire, as organs of motions, a perfection quite wanting among the true sea-stars. On its upper surface the disc generally presents an unbroken edge, but below it is invaded by the arms, which pass along its under surface, quite to the mouth-slits. In describing Ophiuræ the mouth is placed *downwards*, the back of the disc is therefore the *upper* surface, towards the periphery is *outward*, towards the centre *inward*. The solid parts belong to three different systems, the *interior skeleton*, the *skin skeleton* and the *surface skeleton*. This is the arrangement of Gaudry,‡ though his interpretations are not always right, as will presently be seen. The interior skeleton is nothing more than the ambulacral plates turned upwards and inwards, soldered by their sides in pairs and enclosed by the interambulacral plates. It consists of a series of discoid joints (*ossicula ambulacralia—ossicules discoides*, Gaudry—*Ambulacralwirbel*, Joh. Müller,) which follow each other, like vertebræ, and are connected, partly by a sort of hinge, and partly by muscular bands extending from joint to joint. Each joint has an incision above and below, indicating the line of juncture of the two halves of which it is made up. The outer end of each joint carries a part of the hinge, consisting of three teeth, whereof the lowest runs upwards and is embraced by the two uppermost; on the inner end of the following joint is fixed the corresponding part of the hinge, namely, two edges diverging from each other below, but joined above. On the lower side is a conical cavity for the root of the tentacle.

This is the structure among the typical Ophiurans; but two points, mentioned by Gaudry in *Asterophyton*, deserve notice. The first is, that, when the arm divides in two equal branches,

* Additamenta ad historiam Ophiudarum. Af det Kgl. danske Videnskabernes Selskabs Skrifter. 5te Række 5te Bind. For this Abstract the Journal is indebted to Theodore Lyman of Boston.

† In certain species of the genus *Ophiactis* (Lütken) and in *Ophiocoma pumila* (Lüt.).

‡ Annales des Sciences Naturelles, 3me Serie Zoöl. xvi, 339.

the joint, just before the fork, has two discs, instead of one; when on the contrary a small branch is given off from the leading stem, the joints of the small branch may be traced between the joints and the skin of the stem until they become mere grains, and so disappear. And secondly, the roots of the tentacles are, in *Asterophyton*, fixed between the joints, while among the Ophiuræ they are received in a conical hole in the joint itself. The two innermost joints are the only ones which deviate much from the form already described. These are modified to form the jaw apparatus. The component halves of the last joint but one, though still remaining united, bend to the right and left, in the direction of the corresponding pieces of the neighboring arms on either side; but the halves of the innermost joint of all are completely sundered, and, inclining to the right and left, are soldered to the corresponding pieces of the neighboring arms on either side. It is these latter pieces that give the outline to the five triangular projections, which bear all the chewing apparatus (*Mundeckstücke*, Müller; *scutella oralia* or *mouth-frames*). These mouth-frames, on their sides, may be beset with mouth-papillæ. To their inner point is attached a vertical plate, the "jaw" (*maxilla, torus angularis*, Müller), and this bears the teeth (*dentes*) and the tooth-papillæ (*papillæ dentales*). Müller, in the "System der Asteriden" uses the word "*maxiller*" at random for mouth-frames and jaws. These parts are commonly visible on the outside, but, in Ophioderma and allied genera, they are covered with grains. All the rest of the interior skeleton is hidden by the skin-skeleton. Müller and Troschel, in the same work, point out the homology between the discs in the arms of the Ophiuræ and the joints in those of star-fishes; but as they started with the idea that these joints constituted a true internal skeleton, they came to the opinion that this was peculiar, and not to be found in any other Echinodermata. Gaudry, also, does not consider the interior skeleton of Ophiurans as homologous with ambulacral plates, but looks on it as a special structure in serpent-stars. It is in the side arm-plates that he finds the homologues of the ambulacra.

The *skin-skeleton* proper is to be found in the scales on the disc, the genital plates and the four rows of plates on the arms called upper, under and side plates (*scutella dorsalia, ventralia, lateralia*). To the jointed structure of the interior arm-skeleton corresponds, consequently, a similar one in the skin-skeleton. An upper, an under, and two side plates together form a joint, and this corresponds to a joint of the interior skeleton, except that the plates extend beyond their proper joint to the next outer joint. The four plates sometimes lie side by side, but again the side plates may alternate with the others, particularly when the former are little developed. As to their form, the upper plates,

s a general rule, occupy the whole upper surface of the arm, ut the under plates may be square or eight-sided, and are often ut out on the sides to give room for the tentacle scales. The nnermost under plate varies in shape, and is often very small. At the extremity of the arm the joints are proportionately longer nd are contracted at their bases; the upper and under plates ecome smaller and are supplanted by the side plates, which neet on the middle lines above and below, and at last constitute lmost the whole covering of the tip joints. Therefore, the hape of the plates, exposed as it is to constant changes, should lways be referred to the portions of the arm close to the disc. These modifications appear sooner in species with short and uickly tapering arms, than in those with longer and more slen- er ones. There are, however, many serpent-stars, the inner lates of whose arms present features usually seen only at the xtremities (e. g. *Ophiura*). The upper plates are sometimes ivided in pieces by transverse lines; (compare species of *Ophio- erma*, and *Ophiolepis imbricata*, *O. triloba*, *O. Nereis*, *O. Januarii*). *Ophiomyxa* and *Ophioscolex* are supposed to have the skin skeleton eplaced by a soft dermal envelop, but there may still be seen races of arm plates; at least in *Ophiomyxa*. The whole group f Euryalæ has the skin-skeleton either quite wanting or very udimentary; but, to balance this, the exterior skeleton is highly eveloped. According to Gaudry, the four rows of little bony ieces on the under side of the arm and under the skin, among Euryalæ, correspond to the arm-plates. Along each genital pening, between it and the arm, and not visible from the outside, uns a narrow, sloping piece, the genital plate (*scutum genitale*). ts narrow end is turned inward and sometime touches a terminal iece, running from the lateral mouth-shield upwards. The out- ide end of the genital plate is joined with a smaller supplement- ry piece, which extends vertically upwards and unites again ith the radial shields, at a point near the edge of the disc. These parts are never wanting: they are present, even when all ther portions of the skin-skeleton have disappeared. Among e various plates and shields covering the disc are reckoned, rst: the mouth-shields (*scuta oralia*), five in number, ranged in circle about the mouth and placed in the interbrachial spaces, ust outside the mouth-frames. One of these may bear the adreporic body, and is then usually somewhat different from s companions in shape. The madreporic body appears as a light depression or elevation on the surface and communicates eneath with the "stone-canal." Along the edge of the madre- oric mouth-shield there are sometimes pores.* Secondly: the teral mouth-shields (*scutella adoralia*), which are just inside

* See J. Müller: Über die Gattungen der Seeigellarven, 1833, page 33, and e Conte, Proc. Phil. Acad. v, p. 317, 18.

the mouth-shields and vary considerably in shape, position and size. They are arranged in pairs, a pair to each mouth-shield. Thirdly: on the back of the disc, and placed over the base of each arm, are five pairs of radial shields (*scutella radialia*), very conspicuous, when not covered by skin, spines or the like, for their peculiar form, regular position, and greater size. Fourthly: the other parts of the surface of the disc may be covered with scales, of a great variety of shapes and sizes, but usually small and rounded.* Among these scales may be pointed out two which are sometimes found (e. g. *Ophiothrix*). They start from the outer edge of the mouth-shield and run along each edge of the genital opening.

Sometimes the skin-skeleton, on the disc, is naked, (some species of *Ophiolepis* Müll. and Trosch.), but generally it is covered by a tegument of grains, or short spines (*Ophioderma*, *Ophiarachna*, *Ophiopeza*, *Ophiocoma*, *Ophiostigma*, *Ophiacantha*) granular plates and spines (*Ophiopholis*) or thorny spines (*Ophiothrix*). This tegument, together with the teeth, teeth-papillæ, mouth-papillæ, tentacle-scales and arm-spines, constitutes the *surface-skeleton*. Among the Euryalæ this covering is highly developed, and in some sort takes the place of the true skin-skeleton. On the outer parts of the arms and sometimes over the whole body, the rows of grains are armed with hooks. The lower edges of the mouth-slits may be ornamented with mouth-papillæ, which vary in size, shape and number, they may be entirely wanting (in *Ophiothrix*); in *Ophiomyxa* they take the form of lobes, beset with fine points, *Ophiactis* has but one or two on each side of the mouth-frames, *Amphiura* three, while *Ophioderma* may attain even to ten. The teeth proper are plates, arranged in a vertical row along the jaw; and the teeth-papillæ are only grains or short spines which may replace a part or the whole of the teeth; (compare *Ophiocoma* and *Ophiothrix*). It is in *Asterophyton* that the perfect homology of these variable organs is distinctly shown; in this genus all the chewing apparatus takes on the form of sharp spines. Along the underside of the arm runs a double row of pores, from which the tentacles protrude, and, on the inner side of each pore, one, two, or even four scales or papillæ (*papillae ambulacrales*) are placed, which serve to cover the tentacle when it is drawn in. They may, however, be entirely wanting (in *Ophiomyxa* and *Ophiothrix*). When there are more than one on the basal pores of the arm, they decrease in number towards the tip. At the outer end of each mouth-slit are two tentacles (*pedes orales*) which are the last pair at the base of the arm. These, according to Forbes, are used to remove the undi-

* For further remarks on the Ophiuran Skeleton, see J. Müller: Über die Ophiurenlarven des Adriatischen Meeres, 1851, p. 1, and, Über den Bau der Echinodermen, 1853, p. 51 and 76.

d food from the mouth. The side plates of the arm carry rm-spines (*spinae laterales vel brachiales*). These are arranged ts, and, at the pleasure of the animal, may be raised from rm, depressed, with their points outward, and spread and d like a fan. They are placed either along the outside border e plate, in which case they are small and usually pressed to the arm; or else on a little ridge in the middle of the , and then their length is greater and their normal position ght angles with the length of the arm. They are never en- y wanting, but vary, in number from two to ten; in length, one half (*Ophiura nodosa*, &c.) to six times (*Ophiothrix*) length of a joint; and in form, from the small, smooth, -like papilla of *Ophioderma* to the long glossy, thorned of *Ophiothrix*. As to their arrangement in the vertical , they are either all of the same length, or they decrease lowest to highest and *vice versa*, or, finally, from one of middle ones towards each end of the row. When they are h and pointed, the lowest one, at least in the young animals on the outer joints of the old, is commonly changed to a hook. A striking instance is not wanting to show the ; homology between the spines and tentacle scales, for, on nnermost joint of *Ophiura texturata* these parts are so alike, they cannot be distinguished. Towards the tips of the arm spines diminish in number but increase in proportionate h.

Growth of Ophiurans.

e variations which the Ophiuran is subject to, from the time ves the egg till the serpent-star emerges from the larval con- n, are explained in Joh. Müller's most admirable investiga- of the metamorphoses of the Echinodermata. In regard e variations it undergoes, after the metamorphosis has taken , we know little or nothing, except that these variations are mimportant. The serpent-star does not appear completely ed on emerging from its larval form; when newly born rambling about on the surface of the water, it is not more the full grown animal, than a young opossum is like its nts. We may see perhaps, that they belong to one or the of the Ophiuran series, but, as to the species, we can only s at it from the locality or abundance of the specimens. in the half grown animal there are still such variations the adult form that the identity might be doubted were not intermediate steps known. It is therefore plain, that the iption of a species is not full, until several ages of that es have been properly illustrated. The following table will approximately some changes which take place during the th of *Ophiopholis aculeata* (*Ophiolepis scolopendrica*). The eter of the disc, the length of the arms, the number of joints

in the arms, the number of joints with hooks on the under side and the number of joints without a circle of grains round the upper arm-plate are brought into immediate comparison.

Diameter of disc.	Length of arm.	No. of joints.	Joints with hooks.	Joints without circle of grains.
2 mm.	6 mm.	20	15	12
3		40	27	
4		45–50	33	20
6	33	63		
10	60	86		
14	72	105	40–50	18

According to this table both the disc and the arms continue to grow, but the latter the faster. During the growth of the arms new joints are formed, and this increase of joints seems greatest in the very young animal. The new joints appear at the tip of the arm and not at the base, next the mouth.

Subdivisions of genus Ophiolepis (Müll. & Trosch.).

This genus is thus described by its authors: "Naked scales, or little shields, on the disc. Mouth-slits surrounded by a single row of hard papillæ, without an increase of their number over the tooth-columns." It will presently appear, however, that the species included under this definition represent several genera. Following the suggestions of Forbes, it will be seen, that *Ophiolepis* includes two series of scaly Ophiurans, one answering in some sort to the type of *Ophioderma*, the other to that of *Ophiocoma*, as expressed in the following table.

First Series—Type of *Ophioderma.*

Mouth-shields lyre- or shield-shaped extending outwards into the interbrachial spaces, so as to separate the inner ends of the genital opening. At the base of the arms, incisions in the dorsal side of the disc. Arm-spines more or less closely pressed to the sides of the arm, and arranged along the outer edge of the side arm-plates.

Ophiura.—Disc covered with larger or smaller scales, smooth and naked radial shields tolerably large, protruding, more or less distinct. Incision in the disc limited by two arches curving outwards, and admitting three to four imperfect upper arm-plates; on its edges a close crest of from ten to thirty papillæ, which are continued underneath, along the edge of the genital opening, to the mouth-shield. Another more obscure crest of papillæ lying under the first and running only a short distance. Mouth-shields very large, generally longer than broad, shield-shaped, extending into the interbrachial spaces, thus separating the inner ends of the genital opening: the madreporic shields not differing in form. Side mouth-shields narrow, lying inside the mouth-shields prop-

er; joined at apex; their outer ends separating the mouth-shield from the innermost arm-plate. Teeth narrow, pointed, shaped like a spear-head. Mouth-tentacles coming from slits which lie just within the innermost arm-plate, and which open obliquely into the mouth-slits giving them the appearance of a Y. These slits for the tentacles are surrounded with from four to eight papillæ. Arms conical and pointed; short or of moderate length. Upper arm-plates somewhat broad. Lower arm-plates seldom touching each other, by reason of the side arm-plates which lap over and meet on the middle line of the arm. Tentacle-scales one to four. Spines short and smooth, generally arranged in three rows, on the outer edge of the side arm-plate, and pressed close to the arm. Mouth-frames furnished with mouth-papillæ. Species: *O. affinis*, *O. carnea*, *O. Stuwitzii*, *O. nodosa*, *O. squamosa*, *O. albida*, *O. Sarsii*, *O. Wetherelli* (London clay), two species from the chalk, and *O. abyssicola*, which may be an *Ophiocten*. This genus is essentially of the cold sea-belt, north of 30° North Lat.

Ophiocten.—Disc invested with scales, which are covered with flat grains and larger or smaller round spots. Incision, in disc above arms, slight, not deep enough to receive an upper arm-plate; on its edge a continuous comb of papillæ. Openings for the mouth-tentacles as in Ophiura, but not opening into the mouth-slits. Outer edges of first two or three upper arm-plates beset with papillæ. One tentacle-scale. Radial shields, mouth-shields, side mouth-shields, teeth, arms, lower arm-plates, arm-spines, and mouth-papillæ as in Ophiura. Species: *Ophiocten Kröyeri*.

Ophiolepis.—Mouth-shields small and narrow. No papillæ round the incision in the disc. Innermost tentacle-pores not placed close to mouth-slits. Dorsal scales surrounded by semicircles of small scales. Two tentacle-scales, which are placed obliquely side by side. As this group is put foremost in "System der Asteriden," the name *Ophiolepis* should be reserved for it. It is limited to the hot zone and embraces *O. annulosa*, *O. cincta*, *O. variegata* (Lüt.), *O. pacifica* (Lüt.), *O. paucispina* (Say), an undescribed West-Indian species and two new species from the west coast of America.

Second Series—Type of *Ophiocoma*.*

Mouth-shields small and rounded, not extending outwards into the interbrachial spaces, so that the inner ends of the genital

* Dr. Lütken gives only a sketch of the genera belonging to the second series, as he intends to publish another part of the same work, wherein he will speak of them at greater length. The following are among the new Ophiurans described, or to be described, in the two papers: *Ophiura carnea* (Sars, Ms.) *Ophiura Sarsii* (Lütken), *Ophiura affinis* (Lüt.), *Ophiura squamosa* (Lüt.), *Ophiura nodosa* (Lüt.), *Ophiura Stuwitzii* (Lüt.), *Ophiocten Kröyeri* (Lüt.), *Ophiolepis variegata* (Lüt.), *Ophiolepis pacifica* (Lüt.), and another not yet named: *O. Januarii*, *O. triloba* and *O. Nereis*.

opening approach close to each other, on the outer side of the mouth-shield. Arm-spines mounted on a raised keel, and standing boldly out from the arm. Upper edge of the disc, at the base of the arms, entire and without incision.

Genus 1. Mouth-shields small, rounded, with a small, outward projection, separating the inner ends of the genital opening. On the back of the disc, traces of an incision at the base of each arm. Disc covered with moderate scales. Radial shields not large. Lateral mouth-shields within the mouth-shields proper. Below the teeth, two broad, flat, tooth-papillæ. Upper arm-plates divided in two. Two tentacle-scales. Three to four arm-spines. Species *O. Januarii.*

Genus 2. Arms very long and thin. Disc with very small scales, of which some, near the edge, a little larger. Radial shields very small. Lateral mouth-shields on each side of the mouth-shields proper. Upper arm-plates divided in three. One tentacle-scale. Three short arm-spines. Species: *O. reticulata, O. triloba, O. Nereis.*

Genus 3. Scales of the disc and radial shields rather small. No larger scales near edge of disc. Lateral mouth-shields within mouth-shields proper. Two tentacle-scales. Upper arm-plates covered with many small scales. Species *O. imbricata.*

Genus 4. *Amphiura.*—Disc with small, numerous scales, arranged like tiles. Radial shields very distinct. An inward curve of the disc, at the base of the arms, above. Mouth-shields small, not extending into the interbrachial spaces. Side mouth-shields within the mouth-shields. Teeth broad, quadrangular. Arms extremely long and slender. Upper arm-plates oval. Lower arm-plates quadrangular or five-sided. One, two, or no tentacle scales. Spines feeble, on a slight keel. Disc small. Six mouth-papillæ, sometimes the middle ones moved out, so as to cover the basal ones. Species *A. Chiajei, A. Holbölli, A. Orstedii, A. marginata, A. squamata,* &c.

Genus 5. *Ophiopholis.*—Disc with small and numerous scales, covered below by short spines, above by short spines and grains and by plates arranged in ten radiating rows. Radial shields covered. No incision in back of disc. Mouth-shields small, not extending into interbrachial spaces. Side mouth-shields within the mouth-shields. Teeth very broad. Arms long and thick. Upper arm-plates surrounded by small scales. Lower arm-plates square. One foot-papilla. Arm-spines close set, the lower ones, at the tip of the arm, in form of double hooks. Mouth-papillæ six to each jaw, but none under the teeth. Side arm-plates like little keels. Species *O. aculeata.*

Genus 6. *Ophiactis.*—Disc nearly as in Amphiura, but on some of the scales are a few small spines. Arms five or six, rather short and thick. Teeth broad. One or two mouth-papillæ to

each mouth-frame. Side mouth-shields wedged between first and second lower arm-plate, so as to form almost a ring round the mouth. One tentacle-scale. Three to six rough arm-spines. Seven species.

NEW OR LITTLE KNOWN SPECIES.

Ophiura carnea (Sars, Ms.).—Lütken, p. 41. Tab. I, fig. 6.

Arms rather short. Disc thick, covered above with large, rounded, angular scales. Radial shields shaped like a short, thick pear seed, inconspicuous, separated nearly by a round scale. Incision in the disc with margins almost perpendicular, with a row of twelve broad and flat papillæ on each side, which are continued by fine grains along the genital openings. Two small, perpendicular plates, side by side in each incision of the disc, with a row of papillæ on either side. Length of mouth-shields greater than breadth. and than distance from margin of disc. Under arm-plates like segments of a circle, separated from each other, without exception, by the overlapping side arm-plates. Upper arm-plates in contact at the base of the arm, but, farther out, separated by the overlapping of the side arm-plates. Three thin, weak arm-spines. One tentacle-scale. Diameter of disc 6 mm.; arms at least double that length. Color of upper surface a fine rose. Stands nearest to O. albida, from which it differs by having a thicker disc, arms shorter and broader, the innermost upper arm-plate divided in two, mouth-shields longer, and more of the upper arm-plates separated from each other. County of Bergen, 60 to 80 fathoms; Kongeströmmen, 50 fathoms; Biskopshavnen and Manger, 50 to 60 fathoms.

Ophiura Sarsii (Lütken).—Lütken, p. 42, Tab. I, figs. 3, 4.

Ophiolepis ciliata ? (Stimpson, Invert. of Grand Manan, Smithson. Contrib.).
Ophiolepis ciliata, (Sars Travels in Lofoten and Finmarken).
Ophiura coriacea ? (Lütken, Preliminary Rev.; from Scien. Com. Soc. Nat. Hist.).
Ophiura arctica ? (Lütken, " " " " " " " "
Ophiura glacialis ? (Young ?), (Forbes).

Scale tegument varying somewhat as in allied species. Radial shields shaped like a pear seed, the small end inwards; their length to the diameter of the disc as 1 : 5 or 1 : 6 and to their breadth as 4 : 3. The rest of the scales uniform, but sometimes there is, in the middle of the back, a larger one, with rows, also of larger scales, radiating from it. Scales of under surface growing smaller towards mouth-shields. Incisions in the back of disc very deep, so as to receive four upper arm-plates; on either side a comb of ten to fifteen papillæ, of which the uppermost are on the edge of the radial shields. Outside this comb and often hidden by it, a row of small grains and a similar one along the genital opening. Mouth-shields about as in O. texturata; their length to breadth as 7 : 5. Side mouth-shields narrow and of uniform breadth at the two ends. On each side of the innermost tentacle-pores from five to six papillæ, and between these and the mouth, four to six mouth-papillæ. Upper arm-plates, at base of arms, four or five times as broad as long, but, at the tip, longer than broad. Lower arm-plate, at base of arms, twice as broad as long further out, almost disappearing. Two tentacle-scales generally, but sometimes three, or again only one. Three arm-spines, of which the lowest and shortest is not so long as the side arm-plate; the longest, at the tip of the arm, are as long as the side arm-plates; but, at the base of the arm, double that length. Color, mixed, of green, yellow and gray; sometimes light stripes on arms. The disc attains a diameter of 27 mm.; and the arms a length of 100 mm. Is distinguished from O. texturata by the different number of tentacle-scales, the different form of papillæ at incision in disc, the different shape of lower arm-plates and by wanting the pores at the base of the under surface of the arm. Young, with diameter of 4 to 6 mm., have incisions of disc less deep, fewer and proportionately larger dorsal scales, radial-shields shorter and closer together, upper arm-plates narrower, and often only one tentacle scale. These young resemble, therefore, the full grown *O. albida.* On the whole coast of Greenland, 8 to 60 fathoms, and further south at Tromsöe, also at Spitzbergen, at Floröe and Storsund in Norway, and undoubtedly at Grand Manan Is. (Stimpson loc. cit. *Ophiolepis ciliata*).

Ophiura affinis (Lütken).—Lütken, p. 45, Tab. II, fig. 10.

On the back of the disc a central large scale and fifteen others, arranged in concentric circles round it; between all these are smaller scales. Radial shields short, broad, separated by a wedge of small scales. Mouth-shields much as in *O. Sarsii.* Disc incisions with seven to nine papillæ on each side, which are strongest above. Behind these are secondary papillæ. No papillæ on the genital openings. Upper arm-plates, at the base of arm, touching each other; farther out, longer and narrower. Three thin arm-spines, the two longest equal, and as long as side arm-plates. Only one tentacle-scale. Even the innermost under arm-plates separated by side arm-plates overlapping; and they become, a little way from the disc, semicircular and almost rudimentary, being not larger than a tentacle-scale. Color bright, almost pink, with a variety of stripes on disc and of belts on arms. Diameter of disc 5 to 6 mm. and the length of arms about thrice as many. Bollaerene, Asgaardstrand, 20 to 30 fathoms. Hellebæk, 10 to 18 fathoms. This is the smallest serpent-star of North Europe and, as its name suggests, has more affinity with *Ophiocten* than the other Ophiurae.

Ophiura squamosa (Lütken).—Lütken, p. 46, Tab. I, fig. 7.

(An *O. fasciculata* [Forbes]? Sutherland's Journal of Journey, &c.)

Disc with flat, uniform scales, above rounded, below more oval. Radial shields short, thick, not conspicuous. Incisions of disc bordered by a double row of stout, equally developed papillæ. Genital openings bordered by grains. Mouth-shields small, of a regular shield-shape, as broad as, or broader than long. Side mouth-shields long, narrow, of equal breadth. On each side of the innermost tentacle-pores four or five large, round papillae. Arms thin, rather long. Upper arm-plates broad hexagonal, nearly as in *O. albida* and in young of *O. Sarsii.* Under arm-plates narrow, heart-shaped, the point inwards. One tentacle-scale. The upper arm-spine as long as a joint, and, in large specimens from Greenland, often thickened and somewhat flat; under arm-spine only about half as long. In specimens from Greenland diameter of disc as great as 10 mm.; length of arms 30 mm.; in those from the Sound, disc 7 mm., arms 21 mm.. Color; disc, above dark gray, below, ash gray; arms, green gray with darker bands. Sometimes the color is reddish, or violet, or spotted red and gray. Generally the radial shields make two bright marks, and there is a violet spot on each mouth-shield. Hellebæk, 10 to 18 fathoms; Greenland; Taarbaek; Faröe Is.; Tromsöe; Stötö; Florö; Newfoundland. Young, with a disc of 3½ mm., have thin arms and upper arm-plates very narrow.

Ophiura nodosa (Lütken).—Lütken, p. 48, Tab. II, fig. 9.

This species and *O. Stuwitzii* stand as a separate group under the genus *Ophiura.* They are characterized by the short, stout, knotted arms, numerous tentacle-scales, very small arm-spines, and by the peculiar forms of the mouth-shields and under arm-plates. Upper surface of disc with larger and smaller, somewhat tumid scales, arranged in a rosette in the centre. Radial shields, not conspicuous, touching each other laterally, of equal breadth at each end. Incisions in disc bordered by ten short, broad papillæ in a close row. Mouth-shields twice as long as broad, nearly oval, rounded outwards, pointed inwards, extending far outwards into the interbrachial spaces. Side mouth-shields broader inwards, narrower outwards, and touching one another for some distance. Innermost tentacle-pores opening into the outer end of the mouth-slits. All the tentacle-pores oblique, while in the preceding species only the innermost pair are thus placed. From one to five tentacle-scales, according to distance from the disc. Two or three arm-spines, so short as to be like papillæ. Arms short, thick, pointed, knotted, often only twice as long as diameter of the disc. Upper arm-plates, near disc, hexagonal. Under arm-plates very narrow, the innermost in contact with each other, but the outermost separated by the overlapping side arm-plates. The diameter of the disc reaches 8½mm., the length of the arms 17mm. Greenland, Newfoundland.

Ophiura Stuwitzii (Lütken).—Lütken, p. 49, Tab. I, fig. 8.

Disc thick, high, pentagonal. Arms short, acute, conical. Upper surface of disc with rounded, angular scales, decreasing in size from centre to periphery; under

ice with small scales. Radial shields short and broad, touching each other outs, but within separated by a round scale. Incisions in disc shallow but wide, itting two upper arm-plates. The scales which border the incisions run parallel the arm-plates, so that their combs of papillæ look like the innermost rows of spines; on each side, eight of these flat papillæ growing stronger above. es of papillæ along the genital openings. Mouth shields twice as long as broad, ow, rounded without, within pointed. Side mouth-shields narrow and placed in mouth-shields proper. Mouth-papillæ small on side of mouth-frames, but at inner end, larger and pointed. Under arm-plates, at base of the arms oblong, id, distinctly separated from surrounding parts; but, a little further out, not ed, and having a pentagonal, or hexagonal shape. Tentacle-pores oblique. ng the outer edge of each side arm-plate, and so along the inner edge of each acle-pore, runs a close row of seven broad, flat papillæ, among which it is not ible to distinguish arm-spines from tentacle-scales. The innermost joints of the have tentacle-scales also along the outer edge of the tentacle-pores. In outer ts of arm, only one tentacle-scale and three arm-spines. Upper arm-plates, at e of arms, trapezoidal; further out, rudimentary and triangular. Diameter of 6mm.; length of arms 10mm. Greenland; Newfoundland.

Ophiocten Kröyeri (Lütken).—Lütken, p. 51, Tab. I, fig. 5.

(Syn. *Ophiura sericea* [Forbes] ? Sutherland's Journal of a Journey, &c.).

Upper and under integuments of disc separated by a distinct line. Below, naked, ided scales; above, with ten somewhat oval radial-shields, a rosette of plates in centre and other plates scattered radiately, all of which are separated from each er by a close covering of fine grains, so that the back resembles a pavement of ller and larger stones. Incisions in the disc only indicated by bends, which are dered by a continuous row of papillæ. On the outer edges of the two or three upper arm-plates, a row of papillæ. Mouth-shields a little longer than broad, regular shield-shape; side mouth-shields narrow; mouth-frames conspicuous. ns rather long and thin. Upper arm-plates broad and bounded by straight cross-. Under arm-plates small but proportionately broad, entirely separated by the rlapping side arm-plates. Three arm-spines, about as long as the joints. One tacle-scale, except the innermost pair of pores, where there are four. Mouth-illæ, four or five on each side; teeth pointed as in *Ophiura*. The diameter of the may reach 15mm. Spitsbergen, Arksut (South Greenland), 15 to 20 fathoms.

Amphiura Holbölli (Lütken).—Lütken, p. 55, Tab. II, fig. 13.

[Ophiolepis Sundevalli (Müll. & Trosch.) ?]

Disc flat, with very fine scales below; those above small, except some larger in centre. Radial shields small, oblong, twice as long as broad, narrower inwards, arated by a wedge of three to five scales. Mouth-shields small, angular, rounded, ttle longer than broad. The madreporic shield larger, and porous on its edge. e mouth-shields broad, heart-shaped and lying within the mouth-shields. Teeth are and broad, below them a pair of stout mouth-papillæ; another pair at the er end of the mouth-slits, and a third, lying above the second. Upper arm-tes twice as broad as long, transversely oval. Under arm-plates in contact, tangular. One tentacle-scale. Four to five short, thin spines, as long as the ts. Color whitish. Greenland (Jacobshavn, Godhavn, Arksut). 15 to 50 fath-. Diameter of disc 5mm.; length of arms 35mm.; but it grows larger.

Asterophyton eucnemis (Müll. & Trosch.). Young.

Young specimens with a disc of 3mm., have the arms only once divided; at 4½mm., ce, at 6mm. the arms are divided thrice, and the disc is uniformly covered with rably large grains, but there is, as yet, no appearance of ribs.

OPHIURANS OF GREENLAND.

Ophiura Sarsii (Lütken).
Ophiura squamosa (Lütken).
Ophiura Stuwitzii (Lütken).
Ophiura nodosa (Lütken).
Ophiocten Kröyerii (Lütken).

Amphiura Holbölli (Lütken).
Ophiopholis aculeata (Lütken), (*Ophiolepis scolopendrica*, Müll. & Trosch.).
Ophiacantha spinulosa (Müll. & Trosch.).
Asterophyton eucnemis (Müll. & Trosch.).

As before mentioned, *Amphiura Holbolli* may be *Ophiolepis Sundevalli* of Johannes Müller; while Stimpson's *Asterophyton Agassizii* is probably the same as *A. eucnemis*; and his *Ophiolepis ciliata* is *Ophiura Sarsii*. To the above list is to be added a naked Ophiuran with soft skin and long thin arms, probably an *Ophioscolex*; but no good specimens have yet been obtained. If *O. arctica* turns out not to be a mere variety, there is still an eleventh species.

Finally, *Ophiothrix fragilis* has been reported from Greenland, and other very cold localities; but this is perhaps more than doubtful. On the Scandinavian coast, from Cape Kullen, in the south of Sweden, opposite the north point of Zealand, to Lofoten, on the northwest coast of Norway, there are found nineteen species of Ophiurans. On the shores of Finmarken (northwest coast of Norway) there are, thus far, six species; and on those of Great Britain, thirteen species. The geographical distribution of the Ophiurans of Greenland is as follows:

Ophiocten Kröyeri, *Amphiura Holbölli*,	Greenland and Spitzbergen, limited to the arctic zone.
Ophiura nodosa, *Ophiura Stuwitzii*, *Asterophyton eucnemis*,	Only in the *western* Atlantic; at Greenland and Newfoundland.
Ophiura Sarsii, *Ophiacantha spinulosa*,	Essentially arctic, though found in the northern temperate sea-belt, as well as at Spitzbergen and the European and American coasts of the polar sea.

Ophiopholis aculeata—On both sides of the Atlantic, through the whole arctic and cold temperate zones. *O. squamosa* has probably the same range.

ART. VIII.—*On a Visit to the Recent Eruption of Mauna Loa, Hawaii*; by Prof. ROBERT C. HASKELL, of Oahu College, Honolulu. (From a letter to one of the Editors).

OUR party consisted of Pres. Beckwith, Prof. Alexander, myself and twenty students of the college. Twelve of us went to the source of the flow. Only two persons besides have thus far reached it, though many have visited the stream on the plain between Hualulai, Mauna Kea and Mauna Loa.

The eruption broke out on the 23d of January. No earthquake was felt in any part of the Islands at the time, but dead fish were noticed on the 21st and for a few days afterwards, to the east of Molakai and between Molakai and Oahu. The fish gave no evidence of disease, but seemed to have been parboiled. At Honolulu, 200 miles from the eruption, the atmosphere was exceedingly hazy and thick. So much was this the case that it caused considerable excitement, before the news of the eruption arrived.

Rev. Mr. Lyons of Waimea states that on Sunday afternoon, Jan. 23d, smoke was seen gathering on Mauna Loa. In the evening, lava spouted up violently near the top of the mountain on the north side, and apparently flowed both towards Hilo and towards the west side of the island. This continued but a few

minutes, when at a point considerably farther below the top and farther west, another jet spouted up.

Accounts from Hilo say, that on the night of the 23d it was so light there that fine print could be read without difficulty. After the 23d the light was much less.

At Lahaina, more than 100 miles distant, the whole heavens in the direction of the eruption were lighted up.

Our party started from Honolulu Feb. 1st, and reached Kealakekua on the 3d. Here we learned that the stream from the eruption had reached the sea on the 31st of January, at Wainanalii, about forty miles from the place of eruption. This makes the average progress of the stream above five miles per day. After procuring guides, natives, pack-oxen and mules we started for the source of the flow on the 5th. About noon we had a *view* of the source distant probably 25 miles from us in an air line. The crater was about 150 feet high and 250 feet in diameter (as we afterwards estimated). From within this crater, liquid lava was spouting up to the height of 300 or 400 feet above the top. In shape and movement it resembled a mighty fountain or jet of water, though more inconstant. At one moment it was uncommonly high and quite narrow at the top, at the next not as high but very broad. At night and from a good position near, the view of the jet, according to Mr. Faudrey (the only man who reached the crater while the jet was spouting) was grand beyond all description.

Owing to an accident which befell one of our party, and the failure of water where it was supposed to be abundant, we were delayed two days and induced to divide our party into two divisions. One part returned to visit the flow at a point some twenty miles below by another and easier route. The party who went on, consisting of twelve white persons and thirty kanakas, reached the crater Wednesday evening, Feb. 9, and encamped about two miles from it. Here all fears about water were at an end, for we found snow in abundance within half a mile of our camping-ground. In the evening our view was magnificent. The jet had ceased to play; but two craters, about eighty rods apart, were sending up gas and steam, with appearances of flame. This apparent flame, however, we afterwards ascertained was only fine particles of scoria heated to redness. The noise attending this action was like that of an ascending rocket, very much increased of course, but quite irregular. About half a mile below the lower of the two craters, the stream first made its appearance. For five or six miles its course was well defined, and there were no side-streams. From this point the main stream divided more or less, and on the plain, between the three mountains Hualalai, Kea and Loa, the branches extended over a breadth of three or four miles. Some of these

streams were very broad and sluggish and partially cooled, some were narrow and running, as it seemed, at the rate of two or three miles per hour, burning the jungle and trees before them and vieing with each other in their work of desolation.

For the first few miles the stream appeared to be a series of cataracts and rapids. As it approached the plain between the two mountains, it gradually changed into a net-work of streams, or a lake of fire, embracing numerous islands and sending out streams on all sides. The color of the stream upon its first appearance was a light red approaching to white; on the plain a deep blood-red. From the plain towards Wainanalii the stream was narrow, varying from half a mile to a mile in width, and showing only a dull reddish light.

Such was the view spread out before us. To say that it combined the magnificence of a conflagration with the sublimity of a mighty mountain torrent, may give some idea of it; yet such was the extent and variety of the scene that no adequate comparison can be found. The next morning we moved our camp down to the new lava, about half a mile from the lower crater. Here we melted snow, cooked our food, and boiled our coffee over steam cracks. The day proved very foggy and rainy, but we were able to make some explorations about the craters. On the windward side we could ascend them and look in, though the heat was so great that we could look for a moment only, before turning our faces away. The sulphurous gases also were so strong that we were obliged to close our mouths and noses as we approached to look in. The craters were both very irregular in shape, not only on the outside but in the inside. No liquid lava was seen in either at the time. In each there were two or three separate holes where gases and steam were issuing. The sides of these holes and indeed the entire bottom of the craters were at a white heat. The lava stream appeared to be running underneath these craters, and the holes within seemed to be merely vents for the escape of gases. The craters were formed of fragments of light scoria and lava combined. The lower of the two (the one in which the jet was thrown up for fifteen days) was now open on the lower side. This was not the case while the jet was thrown up, according to Mr. Faudrey. It would seem that the force of the jet broke down the lower side, and that after this the jet ceased to play. The upper crater was closed on all sides.

Above these two craters we visited a third not then in action, but still hot. This was smaller and open on the lower side, and broken down somewhat on the upper side. This was formed, not so much of scoria as of old lava. Above this we could see others still of the same kind, and it is probable that they extend to the place where the lava first spouted out. From that place

to the craters then in action, the stream appears to have flowed under the surface mostly, but to have been forced up to the surface where these craters now inactive appear, by hydraulic pressure, or by the pressure of gases, or by both combined.

The next morning we visited the point where the stream first made its appearance. Here we found the lava rushing out from its subterranean passage, and dashing over cataracts and along rapids at such a rate that the eye could scarcely follow it. The lava was at a white heat and apparently as liquid as water. Only a few feet from where the stream issued, small masses of lava were thrown up from ten to fifty feet into the air, which cooled in falling. The cause of this without doubt was the escape of gas, and we then thought that the gas might come from the stream itself. But about three hours afterwards we returned to the same place, and found that the action had greatly increased. Gases were escaping at two other points a few rods below the point first seen. Pieces of lava were thrown as high as 150 feet, and, at the lowest of the three points, there was a fountain some twenty-five feet high. The bits of lava thrown up cooled as they fell, and had already formed craters ten feet high around two of the points where gases were escaping. It was now evident that the escaping gases were not derived from the stream simply, but issued from a vent, which reached to the common reservoir within or under the mountain. We could not remain to watch this incipient crater and fountain, but we were obliged to commence our return. At night, however, from our encampment, about twelve or fifteen miles below, we could see that the crater had increased considerably and also could see the fountain playing a few feet above, but the course of the stream had now changed in part, and half or more of the lava passed down by a new stream. This dashed all our hopes of seeing another large jet of 300 feet in height; and from a friend of mine who visited the spot three or four days afterwards, I learn that the fountain had ceased, and that the crater increased only a few feet after we left.

Descending by the stream, we were able to follow it on its south side, as a strong wind was blowing from that direction. Here we found good walking, and could with safety approach within a few feet of the channel. The width of the stream was from 20 to 100 feet, but its velocity almost incredible. Some of our party thought it 100 miles per hour. We could not calculate it in any way, for pieces of cold lava thrown into it would sink and melt almost instantly. The velocity certainly seemed as great as that of a railroad car. For eight or ten miles the stream presented a continued succession of cascades, rapids, curves, and eddies, with an occasional cataract. Some of these were formed by the nature of the ground over which it flowed,

some by the new lava itself. The stream had built up its own banks on each side, and had added to the depth of its channel by melting at the bottom. The stream flowed more gracefully than water. In consequence of its immense velocity and imperfect mobility, its surface took the same shape as the ground over which it flowed. It therefore presented not only hollows but ridges. In several places for a few feet the course of the stream was an ascent of five to ten degrees, in one instance of twenty-five. Where the turns in the stream were abrupt, the outside of the stream was much higher than the inside. So much was this the case, that the outside sometimes curved over the inside, forming a spiral. It is needless to add that we were filled with wonder and admiration at the sights we saw.

After arriving at the plain between the mountains we had so much fog and rain that we could explore but little. We however saw "*pahoihoi*" or solid lava forming, and also "*aa*" or clinkers. "Pahoihoi" was formed mostly by small side streams and always by shallow streams, which flowed freely but slowly. They were derived generally from the overflowing of the main stream. After flowing for some distance they became cooled at the end, and as there was little pressure from behind, gradually stopped. The little ridges which give the "*pahoihoi*" a ropy appearance, were caused by the flowing on of the stream for a little after it had cooled forward. These are circular because the sides of the stream cool first, while the centre moves on a little farther. These streams become solid in a short time, cooling through, and not simply coating over. At a subsequent time during the same flow, another layer of "*pahoihoi*" may be formed upon the first, as we saw in several instances.

The clinkers are always formed by deep streams, and generally by wide ones, which flow sluggishly, become dammed up in front by the cooling of the lava and in some instances cooled over the top, forming as it were a pond or lake. As the stream augments beneath, the barriers in front and the crust on the surface are broken up, and the pieces are rolled forward and coated over with melted lava which cools and adheres to them more or less. Then, from the force of the melted lava behind and underneath, the stream rolls over and over itself. In this way a bank of clinkers ten to forty feet high, resembling the embankment of a railroad, is formed. Often at the end of the stream no liquid lava can be seen, and the only evidence of motion is the rolling of the jagged rocks of all sizes down the front of the embankment. Sometimes the stream breaks through this embankment and flows on for a time until it gets clogged up again, and then the same processes are repeated. In this latter case the outbursting stream often carries as it were on its back immense masses of clinkers, which look like hills walking. We found no clinkers

until we reached the plain, and it would seem that none are formed except where the descent is but little, or the lava but imperfectly melted.

There is only one point more of which I will speak. I am not quite satisfied that there is a fissure in the side of the mountain, through which the lava made its exit to the surface. Those of our party who had seen the flow of 1840 and who had no doubt of a fissure in the side of the mountain then, think that there is no fissure in this case. I do not of course believe in the old theory of a perpendicular duct or pipe reaching down to the reservoir of lava, but it seems to me that the lava by the pressure of gases and steam works its way to the surface as the water of springs by hydraulic pressure. Hydraulic pressure also constitutes a part of the force which impels lava. Mauna Loa is full of caves, passages, &c., and very porous, and besides the lava, in case of this flow at least, could melt its way more or less, where it met obstructions. It may be, however, that there is a rent in the side of the mountain.

NOTE.—We have received from Prof. Alexander of Honolulu a map giving the course of the lava, and enabling us to make a correction in the map published in the last number of this Journal. The course there given was copied from the "Commercial Advertiser" of Honolulu. It requires only that the current should be made to flow west-north-west from near its point of starting, and then on reaching the base of Hualalai, bend northwestward into the course given in the map.—EDS.

ART. IX.—*On some points of Agricultural Science;* by SAMUEL W. JOHNSON, Professor of Analytical and Agricultural Chemistry in the Yale Scientific School, and Chemist to the Connecticut State Agricultural Society.

The Absorptive properties of Soils.—It has long been vaguely known, that the soil possesses a remarkable power of absorbing a great variety of bodies. How the soil absorbs odors (more properly the volatile matters that give the sensation of odor) has often been seen in the case of garments upon which the fetor of the American skunk has fallen. The Indians long ago taught that they might be "sweetened" by burying them in the earth; and indeed we are told that these people sweeten the carcass of the skunk by the same process to render it fit for eating. Dogs and foxes bury bones and meat in the ground, and afterward exhume them in a state of comparative freedom from offensive odor.*

* It is well known that some surfaces have a much greater power of attaching odors to them than others. Every person has observed that woolen garments retain smells longer than cotton or linen ones, and it appears that the color with which a cloth is dyed affects its retentiveness for some odors. It is a fact, as the

In the older treatises on agronomy we find allusion made to the power of soils to absorb gases, and this power, especially as exercised toward carbonic acid and ammonia, has been assumed to be of much agricultural significance, although the lack of precise experimental knowledge as to its extent, has been confessed and lamented.

The absorptive power of the soil not only for odors and gases, but also for fixed matters carried into it in a state of solution, is illustrated in certain commonly occurring instances. Thus the wells in densely populated cities, or in the vicinity of barn-yards, or filthy canals, remain sweet and pure for a greater or less period of time, though they must be constantly receiving waters that have been in contact with putrefying animal matters. The filtration of the foullest water through a thin stratum of loamy earth removes all unpleasant effluvium and taste.

In the year 1850 it became known through two interesting articles published in the Journal of the Royal Agricultural Society of England,* that the soil exerts an absorptive power toward certain substances, ammonia and potash especially, but not toward hydrochloric, nitric and sulphuric acids, so that if dilute solutions of hydrochlorate, nitrate, or sulphate of ammonia or potash are filtered through, or agitated with a certain quantity of soil, the salts are decomposed, the bases remain in insoluble combination with the soil, and the acids are found in the solution united for the most part to lime.

Previous to 1850, the absorbent power of the soil was explained as a result merely of the surface attraction of porous bodies. Thus Liebig in his "Chemistry applied to Agriculture and Physiology," referred the condensation of ammonia in soils, to the surface attraction of oxyd of iron, alumina and humus, and compared this power of soils to that exhibited by charcoal, which absorbs 90 times its volume of ammonia gas, and evolves it again on moistening with water. He also says, deciding from analogy but in the absence of experimental data, and erroneously, "*the ammonia absorbed by the clay or ferruginous oxyds is separated by every shower of rain, and conveyed in solution to the soil.*"

The separation of organic odors and coloring matters from foul water by contact with earth, has been considered analogous to the action of animal charcoal, by which, for example, beer

writer has personally observed, that when a skunk has emitted its stench in the cellar of a house, the odor clings most perceptibly to *silver ware* which has been buried among napkins in the recesses of a "china closet" long after it has disappeared from every other article on the premises. It is probable that the soil, or some of its ingredients, "sweeten" a garment as above stated, by first effecting a transfer of the odorous matter from the surface of the fabric to its own surface, and then destroying it by oxydation in the same manner as operated by charcoal and platinum black. See note on p. 73.

* On the absorbent Power of Soils." By H. S. Thomson. Vol. xi, pp. 68–74; and "On the Power of Soils to absorb Manure." By J. Thomas Way, Consulting Chemist of the Roy. Ag. Society. Vol. xi, pp. 317–380; also, vol. xiii, pp. 123–142.

and wine may be deprived of odor,* color and taste, and to that of alumina which forms insoluble *lakes* with organic pigments.

Way, in his comprehensive investigations before alluded to, after studying separately as far as possible the absorptive effect of each ingredient of the soil, was led as a last resort to investigate the relations of the silicates to saline solutions. The simple silicates he found ineffectual and had recourse therefore to the complex silicates. He digested feldspar with solution of chlorid of ammonium but detected no reaction, and thence concluded that the fragments of granitic rocks could not perceptibly decompose saline solutions. In order to trace the action of such silicates as are formed to a small degree in the wet way in soils by the weathering of the granitic minerals, Way next prepared double silicates of alumina with the bases potash, soda, lime and ammonia respectively. In the first place he procured an alumina-potash- or alumina-soda-silicate, by precipitating the soluble alkali-silicates with a salt of alumina; on digesting these double silicates with solutions of lime and ammonia, he succeeded in replacing the potash and soda by lime and ammonia, though but incompletely, for different preparations of his alumina-ammonia-silicate contained but 4·51 to 5·64 per cent of ammonia instead of the quantity equivalent to the partly displaced alkali which, according to him, in case of the alumina-soda-silicate, should be 15·47 per cent.

Way gives as characteristic of this class of double silicates, that there is a regular order in which the commonest protoxyd bases replace each other. He arranges them in the following series:

Soda—Potash—Lime—Magnesia—Ammonia:

and according to him, potash can replace soda but not the other bases; while ammonia replaces them all: or each base replaces those ranged to its left in the above series, but none of those

* Several years ago Stenhouse found that the disinfecting property of charcoal depends, not merely upon the condensation in its pores of odorous matters, but also upon their destruction by the condensed oxygen with which doubtless, it is charged. The writer (after Stenhouse) has kept the carcass of a dead rat all summer long in the working room of the Yale Analytical Laboratory without its evolving any disagreeable effluvium, simply by burying it an inch deep in powdered charcoal. The only odor that is perceived, is a strong one of pure *ammonia*, and in time, all the putrefiable parts of the carcass disappear, the hair and bones only remaining. The animal matters enveloped in charcoal (or other highly porous body capable of condensing oxygen, as platinum black or platinum sponge; probably also most soils, especially those rich in humus) are completely oxydized to water, carbonic acid and ammonia (free nitrogen?), without the appearance of the intermediate and fetid products that occur in putrefaction. The sweetening of meat by charcoal (or earth?) consists in the oxydation (eremecausis) of the putrefying surface. Stenhouse found that platinized charcoal (charcoal ignited after moistening with chlorid of platinum) makes an excellent escharotic and disinfectant for foul ulcers, and latterly the surgeon is employing permanganate of potash—an energetic *oxydizing agent*—for the same purpose.

on its right. Way remarks, that "of course the reverse of this action cannot occur." Prof. Liebig (Ann. de Chem. u. Phar., xciv, 380) has drawn attention to the fact that Way directly contradicts himself in describing the preparation of the potash-alumina-silicate, which may be obtained by digesting either the lime-alumina- or soda-alumina-silicate in nitrate or sulphate of potash, when the soda or *lime* is dissolved out and replaced by potash.

Way was doubtless led into the error of assuming a fixed order of replacements by considering these exchanges of bases as regulated after the ordinary manifestations of chemical affinity. His own experiments abundantly show that among these silicates there is no inflexible order of decomposition, nor any *complete* replacements.

Liebig, in the paper just cited, was led from this contradiction and from other considerations, to reject the conclusions of Way, especially as there was no direct proof that these double silicates exist in soils.

The recent researches of Eichhorn, "Ueber die Einwirkung verdünnter Salzlösungen auf Ackererde," (Landwirthschaftliches Centralblatt, 1858, ii, 169, and Pogg. Ann., No. 9, 1858,) have cleared up the discrepancies of Way's investigation (which is itself one of remarkable interest), and have confirmed and explained his facts.

As Way's artificial silicates contained about 12 per cent of water, the happy thought occurred to Eichhorn to test the action of saline solutions on native hydrous silicates. He accordingly instituted some trials on chabazite and natrolite, an abstract of which is here given.

On digesting finely pulverized chabazite with dilute solutions of chlorids of potassium, sodium, ammonium, lithium, barium, strontium, calcium, magnesium, and zinc, sulphate of magnesia, carbonates of soda and ammonia, and nitrate of cadmium, he found in every case that the basic element of these salts became a part of the silicate, while lime passed into the solution. The rapidity of the replacement varied exceedingly. The alkali-chlorids reacted evidently in two or three days. Chlorid of barium and nitrate of cadmium were slower in their effect. Chlorids of zinc and strontium at first, appeared not to react; but after twelve days, lime was found in the solution. Chlorid of magnesium was still tardier in replacing lime.

Four grams of powdered chabazite were digested with 4 grams chlorid of sodium and 400 cubic centimeters water for 10 days. The composition of the original mineral (I), and of the same after the action of chlorid of sodium (II), were as follows:

	I.	II.
SiO_3,	47·44	48·31
Al_2O_3,	20·69	21·04
CaO,	10·37	6·65
KO,	0·65	0·64
NaO,	0·42	5·40
HO,	20·18	18·33
	99·75	100·37

Nearly one-half the lime of the original mineral is replaced by soda. A loss of water also has occurred. The solution separated from the mineral, contained nothing but soda, lime and chlorine, and the latter in precisely its original quantity.

By acting on chabazite with dilute chlorid of ammonium (10 grams to 500 c. c. water) for 10 days, the mineral was altered, and contained 8·83 per cent of ammonia. Digested 21 days, the mineral, dried at 212°, yielded 6·94 per cent of ammonia, and also had lost water.

These ammonia-chabazites lost no ammonia at 212°, it escaped only when the heat was raised so high that water began to be expelled; treated with warm solution of potash it was immediately evolved. The silicate appears to be slightly soluble in distilled water, the solution giving with solution of iodid of mercury in iodid of potassium, the yellow coloration indicative of ammonia.

As in the instances above cited, there occurred but a partial replacement of lime. Eichhorn made corresponding trials with solutions of carbonates of soda and ammonia, in order to ascertain whether the formation of a soluble salt of the displaced base limited the reaction; but the results were substantially the same as before, as shown by analyzing the residue after removing carbonate of lime by digestion in dilute acetic acid.

Eichhorn found that the artificial soda-chabazite reëxchanged soda for lime when digested in a solution of chlorid of calcium; in solution of chlorid of potassium both soda and lime were separated from it and replaced by potash. So, the ammonia-chabazite in solution of chlorid of calcium, exchanged ammonia for lime, and in solutions of chlorids of potassium and sodium, both ammonia and lime passed into the liquid. The ammonia-chabazite in solution of sulphate of magnesia, lost ammonia but not lime, though doubtless the latter base would have been found in the liquid had the digestion been continued longer.

It thus appears that in the case of chabazite all the protoxyd bases* may mutually replace each other, time being the only

* Eichhorn's observations indicate that the combined (basic?) *water* of a silicate is also liable to be increased or removed. May not the small amount of water of many specimens of properly anhydrous minerals be thus acquired? May not in some cases the loss by ignition in minerals, be due to ammonia that has entered into combination in the same manner?

element of difference in the reactions. Natrolite however was not affected by digestion with chlorid of calcium. Eichhorn suggests that its soda is more firmly combined than that of chabazite.

These observations of Way and Eichhorn promise to yield the most fruitful results, not only to the theory of chemical geology, as elucidating the formation and alteration of minerals, but also to the science of agriculture. The explanation of the retentive power of soils which Way first proposed thus acquires an incalculable significance. It is plainly a true explanation, as now relieved from the constraint of a fixed order of affinities or replacements; though not the only or a complete explanation.

Voelcker in some valuable researches on the absorbent power of a soil for the liquids of the dung-heap (Journal Roy. Ag. Soc. of Eng., xviii, 149) first showed that it is not always true that the bases displace *lime* from soils. He found to the contrary, in one instance, that lime was fixed and potash displaced. This result, as well as the opposite behavior of ammonia-chabazite and natrolite towards solution of chlorid of calcium in Eichhorn's trials, indicate most clearly *that different silicates suffer different displacements, though in general, certain bases react more speedily and are more largely or firmly retained than others.* Obviously a great number of experiments are wanted on the behavior of other silicates, native and artificial, towards saline solutions in various degrees of concentration, and at different temperatures, as well as in mixed solutions, before we can decide many interesting questions suggested by these results; but we have undeniably an important new generalization with reference to the reactions that may occur among minerals and in the soil.

Economy of the Ammonia naturally accumulated in the soil.—Since it has been proved that enormous quantities of ammonia exist in soils in a state of such intimate combination that the usual means (boiling with fixed caustic alkalies) fails to expel it,* the important question has arisen—how may this ammonia be rendered more rapidly available to vegetation than it is, so as in many cases to forestall the necessity for nitrogenous manures.

The displacement of ammonia from the ammonia-chabazite by potash, soda and lime, indicates a partial solution of this question; and may not the remarkably diverse effects of various saline manures, e. g. common salt, gypsum, sulphates of soda and magnesia, and silicate of potash, as well as carbonate and phosphate of lime, depend, to some degree, on reactions analogous to those above described! We know that very small doses

* In 1855 the writer found that there was no limit to the evolution of ammonia, when attempting to estimate it in soils, and Dr. Mayer (Ergebnisse. Ag. Chem. Versuche in München 1 Heft.) could not recover by boiling with caustic potash nearly all the ammonia he purposely added to a soil.

of salt and gypsum, to take familiar examples, often remarkably enhance the productiveness of a soil, and as often fail to produce any good effect, either in small or large applications. Neither of the constituents of common salt is found to much extent in our usually cultivated plants, and soda is often entirely wanting.

The action of common salt and gypsum, especially of the latter, is most frequently similar to that caused by ammoniacal manures, whether these be applied to the soil or administered in gaseous form, as is now done in hot-houses by means of carbonate of ammonia, after the plan proposed by Ville, and is manifested in a more intensely green and luxuriant development of foliage, and increased content of water and of nitrogen. The "fixing power" of gypsum cannot longer be considered a useful quality of this fertilizer *in the soil*, not only because, in the merely moist soil, sulphate of ammonia would react on carbonate of lime, as Boussingault long ago demonstrated, but for the reason that the soil has itself a greater and more than sufficient power to fix ammonia, whether it be present as carbonate or sulphate. It is on the other hand the *unfixing* power of gypsum —its ability to liberate ammonia from the ammonia-silicates, that may in some cases constitute its merit.

General law of Displacement among saline Fertilizers.—We are every day drifting further from what but a few years ago was considered one of the most fixed and beneficial principles of agricultural science, viz. that a substance is chiefly a fertilizer because it directly feeds the plant, and are learning from the numerous recent and carefully conducted experiments with manures, that in very many cases we cannot safely venture to predict what will be the influence of a given application; but find in practice the strangest and most discordant results, it being literally possible to show from the experience of the farm that almost every fertilizer in use has in some instances proved beneficial to every cultivated crop, and in other cases has been indifferent or even detrimental.

We are therefore compelled more and more to regard the *indirect action* of manures, and the principle brought out by the researches of Way and Eichhorn, appears adapted more than any other yet discovered to generalize the phenomena of indirect action, and enable us to foresee and explain them. Proofs are not wanting of the actual operation of this principle in the soil.

Wolff (Naturgesetzlichen Grundlagen des Ackerbaues, 3d ed. p. 148,) found in fact that the ashes of the straw of buckwheat grown with a large supply of common salt, compared with the ashes of the same part of that plant grown on the same soil *minus* this addition, contained less chlorid of sodium but much more chlorid of potassium: there having occurred *an exchange of bases* in the soil.

The probabilities already adduced in favor of the view that ammonia is made available by gypsum, carbonate of lime, &c., are in point, and in the further course of this article other evidences will be brought forward to the same effect. May not the influence of lime and guano (or the carbonate of ammonia resulting from its decomposition,) in some cases be partly due to their fluxing the anhydrous or non-absorbent silicates of the soil, thus giving origin to absorbent silicates, as well as to their displacing effect on silicates already existing?

But it is of little use in the absence of decisive investigations to speculate on these topics except for the purpose of exciting research. A great field is opened here and with this new clue to guide us it should be speedily explored.

Not merely the bases, but, as *a priori* would seem entirely reasonable, the acids also appear to be capable of similar exchanges and substitutions.

Way, Liebig and others, have repeatedly observed that phosphoric acid is absorbed by soils, and from the trials of Voelcker before referred to it would appear that among the acids there occur displacements analogous to those established between the bases. Thus in one experiment in which the drainings of a manure heap were passed through a soil, there were found in an imperial gallon—

	Before filtration through the soil.	After filtration through the soil.
Silica,	·75	2·38
Phosphates of lime and iron,	7·90	1·54
Sulphate of lime,	2·18	7·92
Carbonate of lime,	17·46	79·72
Carbonate of magnesia,	12·88	6·17
" " potash,	85·27	4·29
Chlorid of sodium,	22·85	18·90
" " potassium,	85·25	26·44

In another case were found

	Before filtration through the soil.	After filtration through the soil.
Silica,	4·75	15·08
Phosphates of iron and lime,	36·82	38·14
Sulphate of lime,	7·14	*trace.*
Chlorid of sodium,	50·91	48·48
" " potassium,	30·32	39·49
Carbonate of potash,	148·69	85·93

The entire analyses have not been quoted as I do not now intend to discuss these results fully, but merely wish to direct attention to the fact that in both instances silicic acid (perhaps *only* as the result of an excess of carbonate of potash in the dung-liquor to which the soil was subjected) has been removed from the soil, and phosphoric acid has been fixed by it, while in one case sulphuric acid has been retained and chlorine lost by the soil, and in the other case the reverse has occurred.

Liebig in the paper before referred to remarks that "a clay or lime-soil poor in organic matter, withdraws all the potash and all the silicic acid from a solution of silicate of potash; whereas one rich in so-called humus (humic acid), extracts the potash, but *leaves the silicic acid* in solution."

Oxyd of iron and alumina, or some of their compounds which are present in all soils, are the most obvious means of fixing the phosphoric acid of soluble phosphates, and Thenard (Compt. Rend. Feb. 1, 1858,) has experimentally demonstrated that they do remove phosphoric acid perfectly from solutions of phosphate of lime in water saturated with carbonic acid. Déhérain (quoted in Landwirthschaftliches Centralblatt, 1859, i, 94,) has shown on the other hand that carbonate of lime and ferric phosphate brought together with highly carbonated water, give rise to phosphate of lime and ferric carbonate. According to the same experimenter phosphate of alumina and ferric phosphate are also decomposed by contact with solutions of the alkali-carbonates. Thenard in the paper just cited asserts that silicate of lime and phosphate of alumina decompose each other in carbonated water. However complicated and obscure these reactions may be, it is plain, that, henceforth, *the effect of a solution of one base in displacing other bases from native hydrated aluminous (and ferric?) silicates, and of one acid upon the compounds of other acids with oxyd of iron and alumina, must be considered in the theory of the action of saline manures.*

Water as the medium by which the ingredients of the soil enter the plant.—From his experiments on the absorbent power of soils Way was led to question the influence of water in effecting the distribution of plant-food in the soil, and Liebig in a recent paper on this subject (Uéber einige Eigenschaften der Ackerkrume" Ann. der Chem. u. Phar. cv, 109 et seq.*) has drawn the conclusion that this force in the soil is so powerful that ammonia, potash and phosphoric acid when applied as manures are instantly made quite insoluble, so that we must relinquish the idea hitherto entertained that plants appropriate their food directly from an aqueous solution, and must adopt as an only alternative the doctrine that the roots of the plant themselves attack and solve their nutriment. Liebig is of the opinion that the bodies mentioned cannot be distributed in the soil by the ascending and descending streams of moisture which are perpetually circulating in it, in obedience to gravitation and evapotion, and he adduces analyses of river, spring and drain waters, which are almost free from potash and ammonia to sustain this view.

On the other hand Eichhorn in the paper already referred to, found that *pure distilled water dissolved from a soil much more of*

* See also his "Letters on Modern Agriculture," London, 1859.

all the mineral matters required by vegetation than would be needful to supply any average crop. Henneberg and Stohmann (über das Verhalten der Ackerkrume gegen Ammoniak u. Ammoniaksalzen, Ann. der Chem. u. Pharm. cvii, 170) found that when a soil had been saturated with ammonia, pure water removed it again to a certain extent. Thus 100 grams of soil were treated with 200 c. c. of a solution of chlorid of ammonium (containing 0·693 grams ammonia) and absorbed 0·112 grams of ammonia; on removing one-half of the solution and substituting as much pure water the soil lost 0·009 grams of ammonia as the result of the dilution: by again replacing with water 100 c. c. of the thus diluted solution, 0·014 grams of ammonia were redissolved from the soil, and by five repetitions of this process 0·053 grams or nearly one-half the quantity of ammonia originally absorbed passed again into solution.

Liebig himself in one of his papers (Ann. der Chem. u Pharm. cvi, 201,) has furnished the best illustration of the manner in which one base is made soluble by being displaced from its combination with the soil on the addition of another base. He says—"If sulphate of ammonia in very dilute solution, is brought in contact with soil saturated with silicate of potash, and which does not give up a trace (?) of its potash to water alone, it instantly dissolves a certain quantity of this alkali, which may be easily detected by the common reagents."

Liebig has not overlooked the case of aquatic plants whose roots do not enter any soil, for which, he remarks—"there must of course exist other laws for the absorption of their mineral food; they must absorb it from the surrounding medium."

But there appears to be no reason for supposing that aquatic plants differ from our cultivated crops in the manner of imbibing or appropriating the nourishment which enters the roots, especially since Sachs and Stoeckhardt (Chemischer Ackersmann 1859, p. 28, *et. seq.*) have shown that the cereals and leguminous grains, as well as clover and beets, not only germinate but attain a vigorous development and even blossom; although their roots never come in contact with a solid soil, but merely float in water holding in solution the salts needful to supply them with mineral food.

It must be borne in mind that the amount of mineral (fixed) ingredients in a plant or crop is but a minute fraction (according to Boussingault $\frac{1}{15000}$ on the average, according to Lawes and Gilbert $\frac{1}{3000}$) of the quantity of water which a plant or crop under usual circumstances transpires during its season of growth. We are not surprised then, that agricultural plants are sufficiently fed when their roots are merely surrounded by ordinary well water which is daily changed, or by distilled water mingled with a little vegetable ash into which carbonic acid is daily con-

cted. We know that drain tubes and aqueducts are often oked by a mass of rootlets which have grown from one little er that made its way into them through a narrow crevice, but ıy should the roots of trees and land plants thus develop in ch water unless they find their food in it? In Stoeckhardt's periments *loc. cit.*, it was observed that rye and oats only deloped in a normal manner in saline solutions, when these were luted from six to ten thousand times! and young clover plants ew luxuriantly, putting forth new roots, leaves and blossoms in ofusion, when transferred from the soil to pure water supplied th carbonic acid, to which was added $\frac{1}{1000}$th of clover ashes at had been neutralized with nitric acid.

It is true that most river and spring waters yield by analysis ıt the minutest traces of potash, ammonia and phosphoric acid, ıt we cannot perhaps infer with safety that they are actually so ficient in these ingredients, for it may easily happen, as all emists know, that in the evaporation of a large mass of water aces of salts are likewise carried off,* and in the ignition of line residues, as is customary in the analysis of a water, much ore loss of potash may occur from the ready volatility of chlod of potassium.

But admitting that our analyses are sufficiently accurate to ase calculations upon, and that the soil-water never contains ıore potash for example than river and well waters; viz., from to 10 parts in 1,000,000,† it must be remembered that the lant is by no means compelled to limit itself for its supplies of ıineral matter to that portion of water which it transpires.

The root-cells of a plant placed in a saline solution at once stablish osmotic currents, in virtue of the mutual but unbalnced attractions that exist between the cell-walls, the liquid of he cell, the surrounding liquid and the saline and organic ıatters in solution in these liquids. The assimilating processes oing on in the cells are constantly transporting matters forard into the newer growths; or else removing them from soluon in the sap, and causing their deposition in the solid form. hese are the prime disturbances that operate the currents, and ɔ restore the matters thus removed from the liquids of the rootells, external matters held in solution diffuse inwardly. If a lant has a large leaf surface exposed to the free air, from which rater rapidly evaporates, water diffuses into the root-cells if it be

* In Liebig's Chemistry applied to Agriculture and Physiology (5th German ed., . 102, et seq.,) may be found an account of some of the more striking instances of his volatilization. My friend, Dr. Robert A. Fisher permits me to mention the realt of some of his researches that bear on this point. He found in fact that a uantity (very small indeed but still sufficient to be estimated by volumetry) of ustic *potash* is carried off in the vapor when its aqueous solution is distilled.

† Eichhorn found in 1,000,000 parts of distilled water that had been in contact rith a soil for ten days, 57 parts of potash.

present in the soil, and thus the normal humidity of the structure is preserved. But if the plant be situated in a close hothouse, or in a Ward's case, the atmosphere of which is constantly saturated with aqueous vapor, there can be no evaporation of water from the leaves, there can be no transpiration of water through the plant and no absorption of it by the roots, except to supply what becomes a solid constituent of the tissues or is decomposed in the nutritive process. The same is true of potash or any other substance held in solution in the soil-water. As a result of this principle the land plant collects the potash, phosphoric acid, silica, &c., needed for its organization, from the vastly dilute solutions of these bodies which form the water of wells or of the soil, just as the fucus gathers its iodine from the ocean, although the marvellously delicate reagents which we possess for iodine scarcely enable us to detect this substance even in highly concentrated sea-water.

Says Gmelin, (Handbook of Chemistry, Cavendish Soc's. ed., vol. ii, p. 248,) "the quantity of iodine contained in sea-water is so small that Tennant, Davy, Gaultier, Fyfe and Sarphati were not able to find it. Balard, however, found it in the water of the Mediterranean and Pfaff in that of the Baltic, which is nevertheless very poor in iodine." Otto (Lehrbuch 3d ed., 1st Part, p. 452,) observes "while bromine is easily found if not in the sea-water itself, yet in the mother-liquors obtained by its evaporation, and is prepared from them in large quantities, it is still doubtful if iodine can be detected in them." Again in a note—"It is worthy of remark that in preparing bromine from the mother-liquors of sea-water, iodine, so far as I know, has never made its appearance."

Iodine can be detected in a solution of which it forms but $\frac{1}{3000000}$th part—Otto.

The *selecting power* which is possessed by plants is fully explained and defined by osmotic diffusion. Within certain easy limits the plant imbibes only those kinds of matter and those quantities, which it requires to develop its organism, and which diffuse into it in consequence of assimilation in the cells. These limits are not so narrow or inflexible as to make the finding of the conditions of growth impossible, and within them, the plant lives and expands, but is itself influenced in its life and in the direction of its enlargement, by the quantities, absolute and relative, of the nutritive or soluble matters, that happen to surround it. Could we grow two plants in precisely identical conditions, we should find their composition alike in all their parts. The variations in the composition and amount of the ash of plants is probably connected with the different relative development of the separate organs, and this again (in part) with the relative quantities of food present in the soil water. Thus the ash of

the plant is to a certain extent independent of the soil, but again to a certain extent is affected by it. The absorption of *poisons* by plants is entirely abnormal and does not affect our statement.

Not only does the grand law of osmose (endosmose and exosmose) feed the plant out of such attenuated solutions, but, in all probability it aids the formation of these solutions. Graham has shown in the case of alum and bisulphate of potash that the unequal diffusive tendency of the members of a double salt is powerful enough to decompose it, and he observed that solutions even of the neutral sulphates of potash and soda diffused their basic ingredients into lime-water, more rapidly than the acid; these stable salts thus undergoing partial decomposition.

The investigations of Henneberg and Stohmann already cited, have proved that the absorbent power of a soil is not a purely chemical process, in the ordinary restricted sense; but is in part a physical phenomenon, i. e., it does not depend exclusively upon the presence in the soil, of a certain amount of some peculiar *kind* of matter, but is also related to the *condition* and to the relative amount of acting surface of the various materials which react.

Henneberg and Stohmann found that the *time of contact* between a solution of an ammonia-salt and a soil did not affect the amount of absorption,—as much ammonia being taken up in four hours as in a week. This fact indicates that the absorbing substance is in an extreme state of division, to which the pulverized chabazite of Eichhorn's experiments can bear no comparison.

They found too, that a given soil absorbed out of an equal volume of liquid very nearly the same amount of ammonia from equivalent quantities of all its salts, the *phosphate* excepted.

They observed however that the *relative quantities* of soil, water and the saline substance, affected the results; thus from a stronger solution a greater absolute amount of ammonia was absorbed, while from a weaker solution a relatively greater quantity was taken up: and further, relatively more was absorbed by a given amount of soil, from a solution of given strength when the *volume* of the latter was increased.

Finally they found, as has been already remarked, that by diluting with pure water the solution from which a soil had saturated itself with ammonia, a portion of this body is redissolved.

Thus it appears that the very surface-attractions which determine the solution of solid bodies, and occasion osmotic diffusion, also operate in the soil to influence the chemical affinities which are the prime cause of its absorptive properties. The chemical affinity of silicate of alumina for the bases, (probably too that of oxyd of iron and alumina for some of the acids) is modified by the mass of the reacting substances and by that of their solvent; or in other words the cohesive force of the atoms of the com-

pound silicates, or the adhesive force of water, (solvent action) for the saline bodies, may neutralize or limit the chemical affinity which determines one compound and give origin to another. Hence the chemical substitutions in the soil, and in the case of chabazite: hence too the perpetual presence of all the mineral food of plants in the water of the soil.

We would not by any means deny the direct action of the rootlets of plants upon the soil, an action which though exceedingly obscure and as Prof. Liebig remarks in enunciating his new views "very difficult to form a conception of," we may admit in some cases.

Liebig in his letters on modern agriculture, p. 43, gives this instance: "We frequently find in meadows smooth lime-stones with their surfaces covered with a network of small furrows. When these stones are newly taken out of the ground, we find that each furrow corresponds to a rootlet, which appears as if it had eaten its way into the stone." We may admit in this case that the rootlets have acted upon the stone, but are not therefore necessarily compelled to assume that the dissolved matters have entered the plant or were dissolved as food, for in such lime-soils the excess rather than the deficiency of carbonate of lime is oftener a hindrance to vegetation. In the case of the *Lycopodiaceæ*, which contain *alumina* in large quantity combined with tartaric acid, (Berzelius) or malic acid (Ritthausen) we are, if any where, obliged to look to the plant itself, to account for the entrance into it of a substance absent from all cultivated plants if our numerous analyses are to be credited, and one which is rarely found in river waters, and then in quantity so small as to excite the suspicion that it has been introduced in the reagents, or came from suspended matters.

But it is evident from the facts that have been adduced that it is unnecessary to have recourse to any new theory to explain the access of the soil-ingredients into the plant. In fact it would appear that the view we have felt forced to sustain is the only one admissible in the present state of knowledge—the only one conformable to what we deem well established physical laws.

Conclusion.—The function of the soil.—While the researches of Eichhorn are of the utmost value in aid of the theory of the absorption of fertilizing matters by the soil, they do not suffice to give a full explanation of this process. Doubtless all the reactions that occur between hydrous silicates, sesquioxyds and saline solutions may take place in the soil; but in addition to these a number of other changes must go on there, as the soil is so complex and variable a mixture. The organic matters (the bodies of the humic acid group), which are often though not always present in no inconsiderable quantity in the water extract of fertile soils, can hardly fail to exert an influence to modify the action of the silicates. I have found that a peat (swamp-

muck) from the neighborhood of New Haven, (containing when fully dry 68 per cent of organic matter) which is highly prized as a means of improving the porous hungry soils in this vicinity, and which when drained grows excellent crops, is capable of absorbing 1·3 per cent of ammonia, while ordinary soil absorbs but 0·5 to ·1 per cent.

The great beneficent law regulating these absorptions appears to admit of the following expression: *those bodies which are most rare and precious to the growing plant are by the soil converted into, and retained in, a condition not of absolute, but of relative insolubility, and are kept available to the plant by the continual circulation in the soil of the more abundant saline matters.*

The soil (speaking in the widest sense) is then not only the ultimate exhaustless source of mineral (fixed) food, to vegetation, but it is the storehouse and conservatory of this food, protecting its own resources from waste and from too rapid use, and converting the highly soluble matters of animal exuviæ as well as of artificial refuse (manures) into permanent supplies.

Yale Analytical Laboratory, May 15th, 1859.

ART. X.—*On Fossil Plants collected by Dr. John Evans at Vancouver Island and at Bellingham Bay, Washington Territory.*—In a letter from L. LESQUEREUX to J. D. DANA, dated Columbus, Ohio, May 12, 1859.

Dear Sir,—Supposing that Prof. Heer who is now engaged in publishing a magnificent *Fossil Flora of the Tertiary* of Europe, would be much interested in the examination of the plants of Dr. John Evans' survey, of which a short description is published in the last number of your Journal, I sent him a sketch of the drawings prepared for Dr. Evans' report. I have just received an answer to the communication, and as it fixes the value of my species and gives some opinions which are of great interest to American geology, I take the liberty of translating a part of his letter and sending it to you for publication.

Prof. Heer says: "I have hailed with the greatest delight the news which you give me in your letter of 21st March. They are the first rays of light penetrating the dark night which until now has covered the tertiary flora of America, and the day is close at hand, when the fog which still darkens the wonderful flora of those times will be uplifted, and the New World open to us its treasures. They will prove of the greatest interest for the natural philosophy of the earth, and give us most important information as to the relation of climate at the tertiary epoch, and to the secular progression or distribution of temperature over the whole earth. But it is also of the greatest importance for the

history of the American flora, to discover through the plants of the tertiary the various elements of which it is composed; the time will surely come when we shall be acquainted with the true characters of the different floras and with the history of their formation."

"You very correctly remark that the examination of the tertiary flora of Oregon and Vancouver shows that the flora is nearly related to the European flora of the same epoch. Among your species, we find some which are considered as particularly characteristic of our tertiary; viz. the species of *Cinnamomum*. *Cinnamomum crassipes*, Lsqx., is hardly distinguishable from *C. Rossmaesleri*, Heer. It is a pity that the point of the leaf is wanting; it would at once decide the matter, showing whether the nerves ascend to the point or disappear below it, as is the case in *C. lanceolatum*, which is also very similar.—*Cinnamomum Heerii*, Lsqx., is not so certain in its identity. At any rate, it would better agree with *C. polymorphum* than with *C. Buchii*, which is broader just above its middle. What makes me doubtful here, is that the fine nervules emerge at an acute angle, while in *Cinnamomum* they have a somewhat different direction. Perhaps your drawing in this is not quite correct, for in every other respect, the leaf as far as it is preserved would well agree with our *C. polymorphum*. As to *Planera*, I perfectly agree with you, that it is not possible to separate it from *P. Ungeri*. *Salix Islandica*, Lsqx., in its form and general outline resembles our *Salix macrophylla*. But if the nervation is rightly marked, your leaf cannot belong to that species. In *Salix macrophylla*, as in the willows generally, we have, besides the percurrent secondary nerves united near the margins, some other shorter intermediate secondary nerves, which emerging at an obtuse angle from the medial nerve, extend to the nearest secondary nerve either above or below and join with it. In *Salix macrophylla* these shorter secondary nerves are very close together. But in your drawing I see only secondary nerves running nearly to the margins, and if it is correct your leaf does not belong to a *Salix*. The name you give to this leaf (*Salix Islandica*) is peculiar. Your leaf could not have been brought from Iceland? I received from Copenhagen a very interesting collection of the tertiary flora of Iceland, and among the leaves there are some willows which can not be distinguished from our *Salix macrophylla*. Your maple-leaf appears to be somewhat toothed on the margins. If it is so, it would not belong to *Acer trilobatum*. However, it is not well enough preserved for ascertaining its true species. The place of your *Salisburia* is perfectly right, since a *Salisburia*, *S. adiantifolia*, has been found at Sinigaglia, which place, with Stradella and Guarenne, belongs without doubt to the upper strata of Œningen and consequently to the upper Miocene. Your leaf, Pl. 1, fig. 1, *Quercus Benzoin*, Lsqx., is the most interesting of your species,

; it seems so perfectly to agree with *Oreodaphne Heerii*, Gaud., ıat there is scarcely a doubt of the identity of the two spe-.es. But your leaf does not show the small holes or de-ressions marked in the axils of both the inferior secondary erves. You probably did not remark them. I beg you will gain examine the specimen, and I feel confident that you will nd there a small depression; if so, the identity of species is roved. The form and nervation of the leaves are truly pecu-ar and already suffcient for identification. *Oreodaphne Heerii*, aud., has been abundantly found in the upper Miocene and ›wer Pliocene of Italy, but never till now on this side of the lps. It much resembles *Oreodaphne fœtens* of the Canary isl-nds. You will find it figured in the paper of our friend Gaudin, hich I send you. A second Italian leaf is probably your *Quer-us Gaudini*, Lsqx.: I have at least seen one very like it in Gau-in's new treatise, which is not yet published, and I have not the lates on hand just now. I would take your leaf, Pl. 1, fig. 2, ›r *Ficus multinervis* if the secondary nerves were united in their rched points. This is not marked in your drawing. These econdary nerves are somewhat too straight to belong to *Quercus eriifolia*."

"From these few species, we can already see a near relation etween the American tertiary flora and ours; and in several pecies, this relation passes to a true identity. We may add to our species *Glyptostrobus Œningensis*, Br., and *Taxodium dubium*, ternb. In the U. S. Exploring Exped., during the years 1838–9–42, under the command of Ch. Wilkes, Geol., Atlas, Pl. 21, by ›ana, there is a plate with figures of leaves from Frazer river, and mong them, the two above named species are easily identified. 'ig. 11 and 15 may belong to *Caprinus Gaudini;* but probably he margin of the leaf is not rightly drawn. Fig. 12 is like *Rhamnus Rossmaesleri* or perhaps a *Smilax*. These plants there-ore confirm our conclusion."

"Another important deduction may be drawn from your lants, viz. that in the American tertiary flora, there are some siatic types which no longer belong to the American conti-ent, namely *Cinnamomum* and *Salisburia;* and further an At-antic type, the *Oreodaphne*. There is still an *Oreodaphne* in America; but the fossil species is related to *O. fœtens* of the Canary Islands. A third conclusion taken also from the same lant is that fan-like Palm trees were growing at the same time n the same latitude with *Sequoia* and *Taxodium*, and that there-ore we must admit of a warmer climate in North America at hat epoch. And now from this fact that a flora of the same haracter occurred at the tertiary epoch in Northern Europe and North America, it follows that both parts of the earth had a ike warmer climate. It is a new and very important confirma-tion of the Atlantis! the second that I have received this month.

The first was given me by the collection of tertiary fossil plants from Iceland in which I found a *Liriodendron* (leaves and fruit) very like *L. tulipifera*, L., with six species of Pines, of which one much resembles *Abies alba*. With this, there are leaves of *Alnus*, *Betula*, *Salix*, *Araucaria*, *Acer*, *Sparganium*, *Equisetum*, &c., and in truth, species which agree perfectly with those of the tertiary flora. You will find in the general part of my Flora of the Tertiary, where I give a general survey of the tertiary flora of Europe, a detailed account of these leaves of Iceland, and also of some other parts of Europe from which I have received large collections."

"Your views of the gradation of the flora of North America agree perfectly with what we find in Europe. This led me to believe that the plants of Nebraska belong to the tertiary and not to the cretaceous formation. It is true that I have seen only some drawings which were sent to me by Messrs. Hayden and Meek; but they are all tertiary types. The supposed *Credneria* is very like *Populus Leuce*, Ung., of the lower Miocene, and the *Ettinghausiana* seems hardly rightly determined. Besides it is a genus badly founded, and which has as yet no value. All the other plants mentioned by Dr. Newberry belong to genera that are represented in the Tertiary and not in the Cretaceous. And it is very improbable that in America the cretaceous flora has had the characteristic plants of the tertiary; and this would be the case if these plants did belong to the Cretaceous."*

To this most interesting letter of Prof. Heer, I can only add a few words of explanation about his remarks on my species. I owe to the kindness of Dr. John Evans the privilege of still having his specimens in my possession; I was therefore enabled to again examine the only specimen of the leaf which according to Prof. Heer is referable to *Oreodaphne Heerii*, Gaud. Though the specimen is one of the best preserved of the collection, there is no trace of the mentioned pimples or depressions at the axils of the basilar secondary nerves as marked in the figure of M. Gaudin's memoir. One leaf agrees in its general outline and by its primary and secondary nervation with an *Oreodaphne*. But the secondary intermediate nerves are large, deeply marked, and perpendicular to the primary one; and the tertiary nervules are also mostly perpendicular to the secondary ones, well marked and mostly percurrent. This last character especially would separate our leaf from the genus *Oreodaphne* and put it rather with the oaks.—About *Salix Islandica* which I referred with

* Prof. Heer had not seen, when he wrote this, the paper by Messrs. Meek and Hayden in our last volume (p. 219), in which it is shown that the beds containing these leaves occur beneath thick strata characterized by Baculites, Ammonites and other fossils of the Cretaceous. Dr. Newberry has also identified similar leaves from beneath the Cretaceous of New Jersey (collected by Prof. G. H. Cook), and others from New Mexico; so that, if the leaves are tertiary our Cretaceous is abolished.—Eds.

doubt to *Salix macrophylla*, it is not possible to say any thing definite. The leaf is printed on coarse shaly sandstone and the secondary nerves are scarcely marked. It is from the general outline of the leaf and its denticulation, that I had to take the characters. The name *Islandica* was accidentally given as indicating a high latitude for a species of willow with such large leaves. It is truly a curious coincidence that Prof. Heer received from the tertiary of Iceland specimens of a species related to or perhaps identical with ours. *Cinnamomum Heeri*, Lsqx., is a true *Cinnamomum* in every character; but *Quercus multinervis*, figured Pl. 1, fig. 2, has apparently the points of the nerves arched and united, and is truly comparable with *Ficus multinervis* and perhaps identical with it. The specimen figured in Prof. Heer's flora is very poor, and our own is badly broken, and the points of the nerves are scarcely discernible.

Art. XI.—*Geographical Notices.* No. VIII.

Results of the recent Explorations in Australia.—We translate from Petermann's Mittheilungen, April, the following important survey of the results obtained in the recent explorations of Australia. It is principally based on official and authentic reports relating to the following expeditions:

1. Stephen Hack's Researches in the Gawler Mts., and at Lake Gairdner, 1857.
2. Major Warburton's Journey to Lake Gairdner, June and July, 1858.
3. B. Herschel Babbage's expedition to the region between Lake Gairdner and Lake Torrens, 1858.
4. Stuart's, Babbage's and Warburton's explorations north from Lake Campbell.

The article in Petermann is accompanied by a map of Australia between 133° and 138° long. east from Greenwich, and between 30°·30′ and 33° S. lat.

In order to obtain a clear insight into the advantages which have been gained by the numerous expeditions, we shall separately consider their scientific and practical results. In regard to the first view, the question arises about the unknown interior of the Continent. Although the newly explored area comprises only four degrees of longitude and as many of latitude, not extending yet one third of the distance between Spencer's Gulf and the Gulf of Carpentaria, there is new reason to assume, that the interior formation and condition of Australia have a far more varied character, than has been generally supposed. It is shown, that there is no uniform desert of stone and sand, but a

succession of tracts of lands useless and useful, part already inhabited and part capable of being so. The lake district west of the Torrens Basin is in itself a very interesting region which has given rise even in Australia to many hypotheses on the origin of the continent. The salty ingredients of the soil, the salt water lakes, and the sea-shore-like plains west of the Torrens Basin described by Stuart, were used as arguments for the supposition that this part of Australia had been lifted out of the sea in a comparatively recent period only; that in its place an arm of the sea formerly existed, which perhaps connected Spencer's Gulf with the Gulf of Carpentaria, whereby Australia was divided into two parts. These hypotheses, though pleasantly drawn out, must however be considered useless and hasty, as by a close scientific physical examination they are as likely soon to be refuted as confirmed. Even Babbage's calculations of his barometrical observations are still wanting and with them the basis most necessary to a physical examination of the country. However, in relation to height, we may assume as tolerably certain, that from Spencer's Gulf in the direction from N. to N.W., plains extend into the interior elevated but little above the level of the sea and separated from each other by plateaux. The Torrens Basin with its lagoons and coast plains forms one of these low tracts, a second one is represented by that series of lakes, which commences with Lake Dutton and ends on the other side of Lake Younghusband in several swamps and sloughs; a third is formed by the great sinkings of Lake Gairdner and its environs. Major Warburton believes that Lake Gairdner is situated below the level of the sea. If this be true, it must also be the case with the Great Salt Lake and the other adjacent lakes,—as we find in Babbage's Reports no intimation of any difference in their height. Without expressing any definite opinion we will only mention, that Gregory, in his previous expedition from Moreton Bay to Adelaide, crossed the Torrens Basin and found by barometrical means that this basin was situated decidedly above the level of the sea. But the Torrens Basin has there, as the most recent travellers in Australia affirm, its greatest depth. Warburton's opinion therefore remains for the present at least improbable.

The area of the discovered lakes is not inconsiderable, as a comparison with the Lake of Constance shows (*Area* 207 Eng. or 9·75 Germ. sq. m.). By a calculation based on sketches of charts we find

Lake Gairdner in the extent given on the chart	2807	E. or	132	G. M.
Great Salt Lake, - - - - -	351	" "	16·5	"
Lake Hart, - - - - - -	140	" "	6·6	"
Pernatty Lagoon, - - - - -	85	" "	4	"
Lake Younghusband, - - - - -	57	" "	2·7	"
Lake Windabout, - - - - -	49	" "	2·3	"
Lake Reynolds, - - - - - -	6·4	" "	0·3	"

Besides the plateaus, which extend in a northerly direction between the Torrens Basin and that row of lakes situated west, and also between these and Lake Gairdner, elevated perhaps only a few hundred feet above the lakes and their low shores, we find frequently series of heights and isolated elevations. With the exception of the Gawler Mountains, 3000 Engl. feet high, they do not seem to be of any consequence, for Stuart asserts in his description of Mount Finke, that this mountain, though only equal to Mount Arden, was the highest he had seen in his travels.

Concerning the other physical conditions of the country, its vegetation, fauna, etc., we shall speak when giving a more detailed report of Stuart's voyage and the further explorations of Babbage and Warburton. We shall only add in this connection a few words on the practical results of the surveys. The best impressions are undoubtedly made by Hack's descriptions of the Gawler Mountains and the region bordering them on the north and east. There, without doubt, extensive tracts of land are found with a sufficient quantity of fresh water and fertile soil well adapted to stations for cattle and perhaps even agricultural purposes, having the advantage of being easily accessible from the coast, to which they lie near. South and west we find those fearful deserts which Eyre passed through, and where Stuart and Foster suffered from hunger. Farther east in the direction of Lake Torrens, the absence of permanent sweet water springs is the greatest impediment to colonization, for good pastures are neither wanting in the low lands along the lakes, nor even on the plateaus, though we find them here in more isolated tracts. The number of springs, however, and fresh water basins seems to increase considerably the nearer you approach the interior, as Stuart's and Babbage's accounts plainly show. Even Major Warburton, one of the Australian *pessimists*, could not but express his surprise at the great number of springs on the pastures discovered by him north of Stuart's Creek, although he sees almost everything in a more unfavorable light than the rest, and thinks a permanent settlement between Spencer's Gulf and Lake Campbell an impossibility. Several thousand square miles of pasture in such a seclusion and separated by girdles of shrubs and stony plains might really seem to be unworthy of notice, if the peculiar character of Australia were not to be taken into consideration. With an increase of 100,000 souls in its population, with its rapid development in raising cattle, the want of new grass-land is felt more severely than almost anywhere else upon the earth.

We shall but add in reference to this subject, that a week after Stephen Hack's return from the Gawler Mountains a price was offered for some 2000 miles of the 4500 English sq. miles of the new discovered pastures. Several cattle owners followed

Babbage's expedition almost upon his steps, and a Mr. Macdonald was about to make Wirrawirralu his permanent station. Swinden and Stuart reserved for their own use considerable tracts of land in those regions which they discovered. A possession of fertile and useful lands is considered advantageous even if hard of access, as on the west side of the Torrens Basin, where a communication with the coast requires considerable exertion and expense. An attempt is made to overcome the want of springs by artesian wells, for which, according to Babbage, the conditions are favorable. Enterprising colonists had commenced boring already last year at different places, as for instance on the northern foot of the Baxter Mountains.

A particular account of Stuart's bold journey of discovery, illustrating and confirming the results which have been stated above, is contained in the Berlin *Zeitschrift für allgemeine Erdkunde* for January, 1859.

Report of the Superintendent of the (United States) Coast Survey, showing the progress of the Survey during the year 1857. Wash., 1858, pp. 18 and 448, 4to, with 72 plates and charts.—This valuable volume, although bearing date of last year, has been distributed only within a few months. In the brief space at our command it is impossible to state in any detail the great amount and variety of important matter which Prof. Bache has in this report so clearly and ably exhibited. The report shows most fully that the Survey is conducted with eminent efficiency, and that the highest theoretical science and the best artistic skill are brought to bear on this great national work. The astronomical, magnetic, and tidal observations so extensively carried on by the officers of the survey, are, in addition to their direct importance, of great value to the general interests of science.

The appendix, which comprises pages 121—445 of the volume, is rich in valuable notices and papers. Among these may be specified those by the accomplished Superintendent, on the *Atlantic Coast Tides*, and on the *Winds of the Western Coast of North America*, the memoir by Lieut. E. B. Hunt on an *Index of Scientific References*, and the Report by Mr. J. G. Kohl on the *Western Coast Annals of Maritime Discovery and Exploration.*

Numerous charts, diagrams, and other illustrations accompany the volume, and it is well furnished with a table of contents and an alphabetical index, which are so essential to the usefulness of such a work.

We are happy to know that these Reports are distributed with a liberal hand, so that probably every person in the country who can make any use of it, can easily obtain a copy. It gives us pleasure to see also that our government supports the Survey with such enlightened liberality, for we are confident that the outlay yields a full return to the true interests of the nation.

KOHL'S REPORT TO THE U. S. COAST SURVEY ON THE HISTORY OF MARITIME DISCOVERY ON THE PACIFIC COAST OF THE U. STATES.—The Report of the Superintendent of the U. S. Coast Survey for 1857, just published, not only contains as usual important contributions to the hydrography and topography of this country, but many discussions of general interest. Having previously referred to Dr. Kohl's investigations on the coast of the Atlantic and Gulf of Mexico, we here call attention to an outline of his report on the Pacific coast, which is given in the appendix to the volume above referred to. His report begins with a general survey of the physical features of the western coast of the U. States, written from the point of view of the navigator, not the naturalist. To this succeeds a history of discoveries on the Pacific, in groups corresponding with the periods of Cortez, Drake, and Vancouver, whose maritime enterprise was particularly distinguished. By means of notes, full references are made both to the original reports of voyages and to the subsequent discussions of them. A special hydrography of the coast has also been prepared, and two appendixes are added, the first giving reduced copies of maps and charts, ancient and modern, the second a historical map showing the additions to our knowledge made by successive explorers.

We are confident that this work when given to the public will be received with great interest. Its plan is comprehensive and its importance obvious.

DR. M. WAGNER'S VISIT TO THE CORDILLERAS, ON THE GULF OF SAN BLAS.—We find in the *Zeitschrift für allgemeine Erdkunde* (Berlin, Jan. 1859) a Report of Dr. Moritz Wagner's in respect to an important and hitherto unknown part of the Cordilleras. This well-known traveller proposed to determine the following points. 1. Do the Cordilleras, between the Gulf of San Blas and the valley of the R. Chepo consist of one or more chains? 2. Is there, between 9° 1′ and 9° 20′ N. lat. and between 80° 50′ and 81° 30′, a depression in the mountain chain favorable for an interoceanic canal? 3. Is there between the sources of the Chepo and the rivers falling into the Atlantic, really as supposed a plateau, and how high is the same? 4. What is the geological formation of the Isthmus? He condenses the results of his observations in the following words:

1. The Cordilleras, between the Gulf of San Blas and the mouth of Rio Bayano (Chepo), form one central chain passing from east to west through the Isthmus.

2. The average height of this chain is 920 to 1000 Paris feet above the Pacific Ocean at the time of high tide. The highest point reached by Wagner is elevated 1141 feet. Farther north the summits ascend higher, 1800 to 2000 feet. El Generale is estimated not to exceed 2800 feet in height.

3. Another lower chain of mountains extends along the Atlantic coast; behind it the Gulf of San Blas is situated. A valley from three to four leagues in width is extended between both chains, which are now and then connected by transversal ridges. El Generale is such a transversal ridge; it stretches from south to north and divides at the north. The northern slope of the Cordilleras is everywhere steeper than the southern. In the valley many fine prairies are found, being separated from one another by low hills.

4. The valley of Mamoni forms a considerable depression in the Cordilleras, and cuts them, as it were, through. Our camp in the centre of this pass was only 293 feet above Chepo and 374 feet above the level of the Pacific Ocean. Up to this point of the passage the river has from its source a fall of about 120 feet. As to the Madroño nothing reliable could be elicited from the natives; it is however very probable that under this name that river is meant, which on Codazzi's chart is called Rio Mandingo, and which empties into the Gulf of San Blas.

5. Almost all the mountain crests and the northern slope of the Cordilleras consist of granite, which is also found in the beds of the rivers. A great portion of the top is covered with a kind of conglomerate, either of a yellow or red color, in proportion as the oxyd of iron preponderates. Something similar is seen at the summit of Cerro del Ancon near Panama.

It is very interesting to see how at the springs of Rio Chagres the Cordilleras suddenly cease to form a continuous chain, splitting, so to speak, in little round mountains, especially between Panama and Gatim. Here also the granite disappears, being replaced by porphyry, dolerite or trap.

No part of the Cordilleras between the Gulf of San Blas and the Rio Chepo gives any indication of the possibility of establishing an interoceanic canal. The most favorable situation for this purpose is still, in Wagner's opinion, the valley of the rivers Obispo and Rio Grande, viz. the present railroad route.

African Explorations.—Petermann's Mittheilungen, for February 1859, contains brief intelligence in respect to several of the African expeditions. We make the following extracts.

Burton and Speke, who have reached the inner African sea, report that there is not one sea only, but four. The one which they have visited they call the Ugidschi; the others, Tschiwa, Nyassa, and Ukerewa.

A letter from the missionary Rebmann has the following interesting remarks, under the date of Sept. 19, 1858. "A new traveller, Dr. A. Roscher, has arrived here. I said to him that I hoped he would first visit Kilimandjaro, that it might be settled whether I had taken white stone for snow, or not. This matter is to me of the highest interest. It seems to me that if it should prove stone the mountain would be so much the more

remarkable. The peak is so white that I could think it nothing but snow, and I was not a little surprised to hear from some learned men in Europe that it was thought to be anything else."

Dr. Baikie's Niger expedition has now been two years in progress without attaining any noteworthy results. The expedition lost its first steamboat on the rocks not far from Rabba. Meanwhile all the world had learned through Dr. Barth's fifth volume, that the great western branch of the Niger, leading to Timbuktoo, offered great difficulties to navigation. It is to be regretted that the other branch, the Benue, had not before been chosen for exploration. It is now proposed to direct attention to it. Baron Krafft, under the name of Hadj Skander, has set out to visit Timbuktoo. Extracts from his diary are promised in Petermann.

The nautical director of Dr. Livingstone's expedition, Captain Bedingfield, has unexpectedly returned to England on account of a disagreement with Dr. Livingstone.

A journey from Natal to the river Limpopo is projected by two of the missionaries. The lower and middle parts of this stream, which is probably after the Zambesi, the most important of East Africa, are as yet quite unknown.

Ondarza's new Map of Bolivia.—Under the authority of the government of Bolivia, a new map of that country has recently been engraved and printed at the office of Messrs. J. H. Colton & Co., New York.

It is based upon the explorations and surveys of Col. Ondarza, Commandant Mujia, and Major Camacho, the former of whom has been engaged in the work for seventeen years, and has lately been supervising in our country this publication of his results.

The chart (which is issued in four sheets), is almost exclusively limited to the territory of Bolivia itself, but the surveys have extended toward the south into the Argentine confederation. Marginal maps are given of the La Plata and Amazon, from the respective surveys of Page and Herndon, and plans of the cities La Paz and Sucre. The depth and rapidity of the principal rivers are stated at numerous points, and the localities in which are found gold, silver, copper, or other metals are also carefully indicated.

We are informed that in the course of the surveys the elevations of more than three thousand points have been barometrically determined, many of them by repeated observations. One of the determinations affords the means of a comparison between an instrumental leveling extending between 13,000 and about 17,000 feet, and the result of an extended series of barometric observations. The elevations of several of the principal mountains are restored by these observations to the figures originally ascribed to them but very much reduced by Pentland in

his map. This is the case with Sorata and Illimani. The elevations which have been ascertained, and further scientific observations will be given in a volume soon to be published on the geography, statistics, &c. of the country.

A statistical table appended to the map gives the population of Bolivia as follows for 1858:

Provinces.	Inhab.
La Paz,	475,322
Cochabamba,	319,892
Potosi,	281,229
Chuquisaca,	223,668
Oruro,	110,931
Santa Cauz,	153,164
Tarija,	88,900
Veni,	53,973
Atacama,	5,273
Savage tribes,	245,000
Total,	1,987,352

The map appears to have been executed with great care in its details, and is a very important contribution to the orography of South America. D. C. G.

Art. XII.—*Alexander von Humboldt.*

Alexander von Humboldt died at Berlin on Friday the sixth of May, having been ill with a severe catarrh accompanied by fever since the 17th of April.

Eulogy by Prof. Agassiz, *before the American Academy of Arts and Sciences, delivered on the 24th of May.*

Gentlemen:—I have been requested to present on this occasion some remarks upon the scientific career of Humboldt. So few days have elapsed since the sad news reached our shore, that I have had no time to prepare an elaborate account of that wonderful career, and I am not myself in a condition in which I could have done it, being deprived of the use of my eyes, so that I had to rely upon the hand of a friend to make a few memoranda on a slip of paper, which might enable me to present my thoughts in a somewhat regular order. But I have, since the day we heard of his death, recalled all my recollections of him; and, if you will permit me, I will present them to you as they are now vividly in my mind.

Humboldt—Alexander von Humboldt, as he always called himself, though he was christened with the names of Frederick Heinrich Alexander,—was born in 1769, on the 14th of Sep-

—in that memorable year which gave to the world those
hers, warriors and statesmen who have changed the face
e and the condition of affairs in our century. It was in
r that Cuvier also and Schiller were born; and among
iors and statesmen, Napoleon, the Duke of Wellington
ning are children of 1769, and it is certainly a year of
e can say that its children revolutionized the world.
e early life of Humboldt I know nothing, and I find no
except that in his tenth year he lost his father, who had
Major in the army during the seven years' war, and after-
chamberlain to the King of Prussia. But his mother
cellent care of him, and watched over his early educa-
'he influence she had upon his life is evident from the
t notwithstanding his yearning for the sight of foreign
did not begin to make active preparations for his trav-
ng her life time. In the winter of 1787–'88 he was sent
University of Frankfort on the Oder, to study finance.
to be a statesman; he was to enter high offices, for which
as a fair chance, owing to his noble birth and the patron-
ould expect at the Court. He remained, however, but
time there.
nding those studies to his taste, after a semestre's resi-
n the University we find him again at Berlin, and there
ate friendship with Willdenow, then Professor of Botany,
at that time possessed the greatest herbarium in exist-
Botany was the first branch of natural science to which
dt paid especial attention. The next year he went to
en,—being then a youth of twenty years; and here he
natural history with Blumenbach; and thus had an op-
y of seeing the progress zoology was making in antici-
f the great movement by which Cuvier placed zoology
w foundation. For it is an unquestionable fact that in
senting a classification of the animal kingdom based upon
edge of its structure, Blumenbach in a measure antici-
uvier; though it is only by an exaggeration of what Blu-
h did that an unfair writer of later times has attempted
ve Cuvier of the glory of having accomplished this ob-
n the broadest possible basis. From Göttingen he visited
ne, for the purpose of studying geology, and in particu-
basaltic formations of the Seven Mountains. At May-
became acquainted with George Forster, who proposed
npany him on a journey to England. You may imagine
impression the conversation of that active, impetuous
l man made upon the youthful Humboldt. They went
um and to Holland, and thence to England, where Fors-
duced him to Sir Joseph Banks. Thus the companions
. Cook in his first and second voyages round the world,

who already venerable in years and eminent as promoters of physical science not yet established in the popular favor, were the early guides of Humboldt in his aspirations for scientific distinction. Yet Humboldt had a worldly career to accomplish. He was to be a statesman, and this required that he should go to the Academy of Commerce at Hamburg. He remained there five months, but he could endure it no longer, and he begged so hard that his mother allowed him to go to Freyberg and study Geology with Werner, with a view of obtaining a situation in the Administration of Mines. See what combinations of circumstances prepare him for his great career, as no other young man ever was prepared. At Freyberg he received the private instruction of Werner, the founder of Modern Geology, and he had as his fellow student no less a man than Leopold von Buch, then a youth, to whom, at a later period, Humboldt himself dedicated one of his works, inscribing it "to the greatest geologist," as he was till the day of his recent death. From Freyberg he made frequent excursions to the Hartz and Fitchtelgeberg and surrounding regions, and these excursions ended in the publication of a small work upon the Subterranean Flora of Freiberg, (Flora Subterranea Fribergensis), in which he described especially those Cryptogamous plants, or singular low and imperfect formations which occur in the deep mines. But here ends his period of pupilage.

In 1792 he was appointed an officer of the mines (Oberbergmeister.) He went to Beyreuth as Director of the operations in those mines belonging to the Frankish Provinces of Prussia. Yet he was always wandering in every direction, seeking for information and new subjects of study. He visited Vienna, and there heard of the discoveries of Galvani, with which he made himself familiar; went to Italy and Switzerland, where he became acquainted with the then celebrated Professors Jurine and Pictet, and with the illustrious Scarpa. He also went to Jena, formed an intimate acquaintance with Schiller and Goethe, and and also with Loder, with whom he studied anatomy. From that time he began to make investigations of his own, and these investigations were in a line which he has seldom approached since, being experiments in physiology. He turned his attention to the newly discovered power by which he tested the activity of organic substances; and it is plain, from his manner of treating the subject, that he leaned to the idea that the chemical process going on in the living body of animals furnished a clue to the phenomena of life, if it was not life itself. This may be inferred from the title of the book published in 1797—"*Über die gereizte Muskel und Nerven-faser, mit Vermuthungen über den chemischen Process des Lebens, in Thieren und Pflanzen.*" In these explanations of the phenomena we have the sources of the first

impulses in a direction which has been so beneficial in advancing the true explanation of the secondary phenomena of life; but which, at the same time, in its exaggeration as it prevails now has degenerated into the materialism of modern investigators. In that period of all-embracing activity, he began to study Astronomy. His attention was called to it by Baron von Zach, who was a prominent astronomer, and at that time was actively engaged upon astronomical investigations in Germany. He showed Humboldt to what extent astronomy would be useful for him, in his travels, in determining the positions of places, the altitude of mountains, &c.

So prepared Humboldt now broods over his plans of foreign travel. He has published his work on the muscular and nervous fibre at the age of 28. He has lost his mother; and his mind is now inflamed with an ungovernable passion for the sight of foreign and especially tropical lands. He goes to Paris to make preparation by securing the best astronomical, meteorological and surveying instruments. Evidently he does not care where he shall go, for on a proposition of Lord Bristol to visit Egypt he agrees to it. The war prevents the execution of this plan, and he enters into negotiations to accompany the projected expedition of Capt. Baudin to Australia; but when Bonaparte, bent on the conquest of Egypt, started with a scientific expedition, Humboldt wishes to join it. He expects to be one of the scientific party, and to reach Egypt by way of Barbary. But all these plans failing, he goes to Spain with the view of exploring that country, and finding perhaps some means of joining the French expedition in Egypt from Spain. While in Madrid he is so well received at the Court—a young nobleman so well instructed has access everywhere—and he receives such encouragement from persons in high positions, that he turns his thoughts to an exploration of the Spanish provinces of America. He receives permission not only to visit them, but instructions are given to the officers of the colonies to receive him everywhere and give him all facilities, to permit him to transport his instruments, to make astronomical and other observations, and to collect whatever he chooses; and all that only in consequence of the good impression he has made when he appeared there, with no other recommendation than that of a friend who happened to be at that time Danish Minister to the Court of Madrid. With these facilities offered to him, he sails in June, 1799, from Corunna, whence he reaches Teneriffe, makes short explorations of that island, ascending the peak, and sailing straightway to America, where he lands in Cumana, in the month of July, and employs the first year and a half in the exploration of the basin of the Orinoco and its connection with the Amazon. This was a journey of itself, and completed a work of scientific import-

ance, establishing the fact that the two rivers were connected by an uninterrupted course of water. He established for the first time the fact that there was an extensive low plain, connected by water, which circled the high table land of Guiana. It was an important discovery in physical geography, because it changed the ideas about water courses and about the distribution of mountains and plains in a manner which has had the most extensive influence upon the progress of physical geography. It may well be said that after this exploration of the Orinoco, physical geography begins to appear as a part of science. From Cumana he makes a short excursion to Havana, and hearing there of the probable arrival of Baudin on the West coast of America, starts with the intention of crossing at Panama. He arrives at Carthagena, but was prevented by the advance of the season from crossing the Isthmus, and changed his determination from want of precise information respecting Baudin's expedition. He determines to ascend the Magdalena river and visit Santa Fé de Bogôta, where, for several months, he explores the construction of the mountains, and collects plants and animals; and, in connection with his friend, Bonpland, who accompanied him from Paris, he makes those immense botanical collections, which were afterwards published by Bonpland himself, and by Kunth after Bonpland had determined on an expedition to South America. In the beginning of 1802 he reaches Quito, where, during four months, he turns his attention to every thing worth investigating, ascends the Chimborazo, to a height to which no human foot had reached, anywhere; and, having completed this survey and repeatedly crossed the Andes, he descends the southern slope of the continent to the shore of the Pacific at Truxillo, and following the arid coast of Peru, he visits finally Lima. I will pass lightly over all the details of his journey, for they are only incidents in that laborious exploration of the country which is best appreciated by a consideration of the works which were published in consequence of the immense accumulation of materials gathered during those explorations. From Lima, or rather from Callao, he sails in 1802 for Guayaquil and Acapulco, and reaches Mexico in 1803, where he makes as extensive explorations as he had made in Venezuela and the Andes, and after a stay of about a year, having put all his collections and manuscripts in order, revisits Cuba for a short time, comes to the United States, makes a hurried excursion to Philadelphia and Washington, where he is welcomed by Jefferson, and finally returns with his faithful companion Bonpland to France, accompanied by a young Spanish nobleman, Don Carlo de Montufar, who had shared his travels since his visit to Quito.

At thirty-six years of age Humboldt is again in Europe with collections made in foreign lands, such as had never been brought

together before. But here we meet with a singular circumstance. The German nobleman, the friend of the Prussian and Spanish Courts, chooses Paris for his residence, and remains there twenty-two years to work out the result of his scientific labor; for since his return, with the exception of short journeys to Italy, England and Germany, sometimes accompanying the King of Prussia, sometimes alone, or accompanied by scientific friends, he is entirely occupied in scientific labors and studies. So passes the time to the year 1827, and no doubt he was induced to make this choice of a residence by the extraordinary concourse of distinguished men in all branches of science with whom he thought he could best discuss the results of his own observations. I shall presently have something to say about the works he completed during that most laborious period of his life. I will only add now, that in 1827 he returned to Berlin permanently, having been urged of late by the King of Prussia again and again to return to his native land. And there he delivered a series of lectures preparatory to the publication of Cosmos; for in substance, even in form and arrangement, these lectures, of which the papers of the day gave short accounts, are a sort of prologue to the Cosmos, and a preparation for its publication.

In 1829, when he was 60 years of age, he undertakes another great journey. He accepts the invitation of the Emperor Nicholas to visit the Ural Mountains, with a view of examining the gold mines and localities where platina and diamonds had been found, to determine their geological relations. He accomplished the journey with Ehrenberg and Gustavus Rose, who published the result of their mineralogical and geological survey in a work of which Rose is the sole author; while Humboldt published under the title of Asiatic Fragments of Geology and Climatology, his observations of the physical and geographical features made during that journey. But he had hardly returned to Berlin, when in consequence of the revolution of 1830, he was sent by the King of Prussia as extraordinary ambassador to France, to honor the elevation of Louis Philippe to the throne. Humboldt had long been a personal friend of the Orleans family, and he was selected as ambassador on that occasion on account of these personal relations. From 1830 to 1848 he lived alternately in Berlin and in Paris, spending nearly half the time in Paris and half the time in Berlin, with occasional visits to England and Denmark; publishing the results of his investigations in Asia, making original investigations upon various things, and especially pressing the establishment of magnetic observatories, and connected observations all over the globe, for which he obtained the co-operation of the Russian government and that of the government of England; and at that time those observatories in Australia and in the Russian Empire to the borders of

China, were established which have led to such important results in our knowledge of terrestrial magnetism. Since 1848 he has lived uninterruptedly in Berlin, where he published on the anniversary of his 80th year a new edition of those charming first flowers of his pen, his Views of Nature, the first edition of which was published in Germany in 1808. This third edition appeared with a series of new and remodeled annotations and explanations; and that book in which he first presented his views of nature, in which he drew those vivid pictures of the physiognomy of plants and of their geographical distribution, is now revived and brought to the present state of science. The "Views of Nature" is a work which Humboldt has always cherished, and to which in his Cosmos he refers more frequently than to any other work. It is no doubt because there he had expressed his deepest thoughts, his most impressive views, and even foreshadowed those intimate convictions which he never expressed, but which he desired to record in such a manner that those that can read between the line might find them there; and certainly there we find them. His aspiration has been to present to the world a picture of the physical world from which he would exclude everything that relates to the turmoil of human society, and to the ambitions of individual men.

A life so full, so rich, is worth considering in every respect, and it is really instructive to see with what devotion he pursues his work. As long as he is a student he is really a student and learns faithfully, and learns everything he can reach. And he continues so for twenty-three years. He is not one of those who is impatient to show that he has something in him, and with premature impatience utters his ideas, so that they become insuperable barriers to his independent progress in later life. Slowly and confident of his sure progress, he advances, and while he learns he studies also independently of those who teach him. He makes his experiments and to make them with more independence he seeks for an official position. During five years he is a business man, in a station which gives him leisure. He is Superintendent of the Mines, but a Superintendent of the Mines who can do much as he pleases; and while he is thus officially engaged journeying and superintending, he prepares himself for his independent researches. And yet it will be seen he is thirty years of age before he enters upon his American travels, those travels which will be said to have been the greatest undertaking ever carried to a successful issue, if judged by the results; they have as completely changed the basis of physical science as the revolution which took place in France about the same time has changed the social condition of that land. Having returned from these travels to Paris, there begins in his life a period of concentrated critical studies. He works up his materials then

with an ardor and devotion which is untiring; and he is not anxious to appear to have done it all himself. Oltmanns is called to his aid to revise his astronomical observations, and his barometrical measurements by which he has determined the geographical position of 700 different points and the altitude of more than 450 of them.

The large collection of plants which Bonpland had begun to illustrate, but of which his desire of seeing the tropics again has prevented the completion he entrusts to Kunth. He has also brought home animals of different classes, and distributes them among the most eminent zoologists of the day. To Cuvier he entrusts the investigation of that remarkable Batrachian, the Acœlotel,—the mode of development of which is still unknown, but which remains in its adult state in a condition similar to that of the tadpole of the frog during the earlier period of its life. Latreille describes the insects, and Valenciennes the shells and the fishes; but yet to show that he might have done the work himself, he publishes a memoir on the anatomical structure of the organs of breathing in the animals he has preserved, and another upon the tropical monkeys of America, and another upon the electric properties of the electric eel. But he was chiefly occupied with investigations in physical geography and climatology. The first work upon that subject is a dissertation on the geographical distribution of plants, published in 1817. Many botanists and travellers had observed that in different parts of the world there are plants not found in others, and that there is a certain arrangement in that distribution; but Humboldt was the first to see that this distribution is connected with the temperature of the air as well as with the altitudes of the surface on which they grow, and he systematized his researches into a general exposition of the laws by which the distribution of plants is regulated. Connected with this subject he made those extensive investigations into the mean temperature of a large number of places on the surface of the globe, which led to the drawing of those isothermal lines so important in their influence in shaping physical geography and giving accuracy to the mode of representing natural phenomena. Before Humboldt we had no graphic representation of complex natural phenomena which made them easily comprehensible, even to minds of moderate cultivation. He has done that in a way which has circulated information more extensively, and brought it to the apprehension more clearly than it could have been done by any other means.

It is not too much to say, that this mode of representing natural phenomena has made it possible to introduce in our most elementary works, the broad generalizations derived from the investigations of Humboldt in South America; and that every

child in our schools has his mind fed from the labors of Humboldt's brain, wherever geography is no longer taught in the old routine. Having completed his American labors, Humboldt published three works partly connected with his investigations in America, and partly with his further studies in Europe since his return, and among others, a book, which first appeared as a paper in the "Dictionnaire des Sciences Naturelles," but of which separate copies were printed under the title of "Essai sur la Constitution des Roches dans les deux Hemisphères." This work has been noticed to the extent which it deserved by only one geologist, Elie de Beaumont. No other seems to have seen what there is in that paper, for there Humboldt shows, for the first time, that while inorganic nature is the same all the world over,—granite is granite, and basalt is basalt, and limestone and sandstone, limestone and sandstone wherever found,—there is everywhere a difference in the organized world, so that the distribution of animals and plants represents the most diversified aspects in different countries. This at once explains to us why physical sciences may make such rapid progress in new countries, while botany and zoology have to go through a long process of preparation before they can become popular in regions but recently brought under the beneficial influence of civilization. For while we need no books of our own upon astronomy, chemistry, physics and mineralogy, we have to grope in the dark while studying our plants and animals until the most common ones become as familiar to us as the common animals of the fields in the old countries. The distinction which exists in the material basis of scientific culture in different parts of the world is first made evident by this work. By two happily chosen words Humboldt has presented at once the results of our knowledge in geology at the time, in a most remarkable manner. He speaks there of "independent formations." Who, before Humboldt, thought there were successive periods in the history of our globe which were independent one from the other? There was in the mind of geologists only a former and a present world. Those words expressing the thought and expressing it in reference to the thing itself, for the first time occur in that memoir; thus putting an end to those views prevailing in geology, according to which the age of all the rocks upon the earth can be determined by the mineralogical character of the rocks appearing at the surface. The different geological levels at which rocks belonging to the same period have been deposited, but which have been disturbed by subsequent revolutions, he happily designated as "geological horizons."

It was about the time he was tracing these investigations that he made his attempt to determine the mean altitude of the continents above the sea. Thus far geographers and geologists had

considered only the heights of mountain chains, and the elevation of the lower lands, while it was Humboldt who first made the distinction between mountain chains and table lands. But the idea of estimating the average elevation of continents above the sea had not yet been entertained; and it was again Humboldt, who, from the data that he could command, determined it to be at the utmost 900 feet, assuming all irregularities to be brought to a uniform level. His Asiatic travels gave him additional data to consider these depressions and swellings of continents, when discussing the phenomena of the depressions of the Caspian Sea, which he does in a most complete manner.

There is a fullness and richness of expression and substantial power in his writing, which is most remarkable, but which renders his style somewhat involved. He has aimed to present to others what nature presented to him,—combinations interlocked in such a complicated way as hardly to be distinguishable, and his writings present something of the kind. You see his works, page after page, running into volumes without division into chapters or heads of any sort; and so conspicuous is that peculiarity of style in his composition, that I well remember hearing Arago turning to him, while speaking of composition, and saying, "Humboldt, you don't know how to write a book—you write without end, but that is not a book; it is a picture without frame." Such an expression of one scientific man to another, without giving offense, could only come from a man so intimately associated as Arago was with Humboldt. And this leads me to a few additional remarks upon his character and social relations. Humboldt was born near the Court. He was brought up in connection with courtiers and men in high positions of life. He was no doubt imbued with the prejudices of his caste. He was a nobleman of high descent. And yet the friend of kings was a bosom friend of Arago, and he was the man who could, after his return from America, refuse the highest position at the court of Berlin, that of the secretaryship of public instruction, preferring to live in a modest way in Paris, in the society of all those illustrious men who then made Paris the centre of intellectual culture. It was there where he became one of that Societé d'Arcueil, composed of all the great men of the day, to which the paper on "Isothermal Lines" was presented, and by which it was printed, as all papers presented to it were, for private distribution. But from his intimate relations especially to the court of Prussia, some insinuations have been made as to the character of Humboldt. They are as unjust as they are severe in expression. He was never a flatterer of those in power. He has shown it by taking a prominent position, in 1848, at the head of those who accompanied the victims of the revolution of that year to

their last place of rest. But while he expressed his independence in such a manner, he had the kindliest feelings for all parties. He could not offend, even by an expression, those with whom he has been associated in early life; and I have no doubt that it is to that kindliness of feeling we must ascribe his somewhat indiscriminate patronage of aspirants in science, as well as men who were truly devoted to its highest aims. He may be said to have been, especially in his latter years, the friend of every cultivated man, wishing to lose no opportunity to do all the good of which he was capable; for he had a degree of benevolence and generosity which was unbounded. I can well say that there is not a man engaged in scientific investigation in Europe, who has not received at his hands marked tokens of his favor, and who is not under deep obligations to him. May I be permited to tell a circumstance which is personal to me in that respect, and which shows what he was capable of doing while he was forbiding an opportunity of telling it. I was only 24 years of age when in Paris, whither I had gone with means given to me by a friend; but was at last about to resign my studies from want of ability to meet my expenses. Professor Mitscherlich was then on a visit in Paris, and I had seen him in the morning, when he had asked me what was the cause of my depressed feelings; I told him that I had to go for I had nothing left. The next morning as I was seated at breakfast in front of the yard of the hotel where I lived, I saw the servant of Humboldt approach. He handed me a note, saying there was no answer and disappeared. I opened the note, and I see it now before me as distinctly as if I held the paper in my hand. It said:

"My friend, I hear that you intend leaving Paris in consequence of some embarrassment. That shall not be. I wish you to remain here as long as the object for which you came is not accomplished. I enclose you a check for £50. It is a loan which you may repay when you can."

Some years afterwards when I could have repaid him I wrote, asking for the privilege of remaining foreyer in his debt, knowing that this request would be more consonant to his feelings than the recovery of the money, and I am now in his debt. What he has done for me, I know he has done for many others; in silence and unknown to the world. I wish I could go on to state something more of his character, his conversational powers, &c., but I feel that I am not in a condition to speak of them. I would only say that his habits were very peculiar. He was an early riser, and yet he was seen at late hours in the saloons in different parts of Paris. From the year 1830 to 1848, while in Paris, he had been charged by the King of Prussia to send reports upon the condition of things there. He had before prepared for the King of Prussia a report on the political condition of the

Spanish Colonies in America, which no doubt had its influence afterwards upon the recognition of the independence of those colonies. The importance of such reports to the government of Prussia may be inferred from a perusal of his political and statistical essays upon Mexico and Cuba. It is a circumstance worth noticing that above all great powers Prussia has more distinguished; scientific and literary men among her diplomatists than any other State. And so was Humboldt actually a diplomatist in Paris though he was placed in that position, not from choice, but in consequence of the benevolence of the King, who wanted to give him an opportunity of being in Paris as often and as long as he chose.

But from that time there were two men in him,—the diplomatist, living in the Hotel des Princes, and the naturalist who roomed in the Rue de la Harpe, in a modest apartment in the second story; where his scientific friends had access to him every day before seven. After that he was frequently seen working in the library of the Institute until the time when the Grand Seigneur made his appearance at the court or in the saloons of Paris.

The influence he has exerted upon the progress of science is incalculable. I need only allude to the fact that the Cosmos, bringing every branch of natural science down to the comprehension of every class of students has been translated into the language of every civilized nation of the world, and gone through several editions. With him ends a great period in the history of science, a period to which Cuvier, Laplace, Arago, Gay-Lussac, Decandolle and Robert Brown belonged, and of whom only one is still living,—the venerable Biot.

ART. XIII.—*On the origin of Vibrio;* by H. JAMES CLARK of Cambridge, Mass.

(From the Proceedings of the American Academy, Boston, April 12, 1859.)

A FEW months ago a French physiologist, Pouchet, revived the long-exploded doctrine of equivocal or spontaneous generation, and asserted that he had been able to obtain certain living beings from substances which were entirely shut off from the outer world, and in which, after having undergone certain preparations, there could not possibly be any germs of these animals. A discovery, which I made on the 20th of March, may not be uninteresting, as it has more or less relations in its nature to the theory so earnestly advocated by Pouchet. There are certain well known bodies described as animals by Ehrenberg, under the name of Vibrio; their peculiarity consists in that they are

composed of a single row of globular bodies, resembling a string of beads, more or less curved, and move in a spiral path with great velocity, even faster than the eye can follow in many cases. They exhibit, by their activity, more plausible signs of animality than any of the Desmideæ or Diatomaceæ, and fully as convincing indications of life as the spores of Algæ, to which they were first referred by the late lamented Dr. W. I. Burnet, and after him by Rudolph Wagner and Leuckart. They have always been spoken of as developing around decaying animal and vegetable matter. I was very much surprised to discover the manner in which they orginate from such substances. I was studying the decomposing muscle of a Sagitta, a little crustacean, as I consider it,—which, in passing, I would observe was found by me a year ago last March, for the first time in this country, at Lynn Harbor,—when I noticed large numbers of Vibrio darting hither and thither, but most frequently swarming about the muscular fibres. I was struck with the similarity of these bead-like strings to the fibrillæ of the muscle, and upon close comparison I found that the former were exactly of the same size, and had the same optical properties as the latter. Some of these appeared to be attached to the ends of the flat, ribbon-like fibres, and others at times loosened themselves and swam away. I was immediately impressed with the daring thought, that these Vibrios were the fibrillæ set loose from the fibres; but as this was a thing unheard of, and so startling, I for the time persuaded myself that they must have been accidentally attached and subsequently loosened. However, I continued my observation until I found some fibres in which the fibrillæ were in all stages of decomposition. At one end of the fibre the ultimate cellules of the fibrillæ were so closely united, that only the longitudinal and transverse striæ were visible; further along, the cellules were singly visible, and still further they had assumed a globular shape; next, the transverse rows were loosened from each other excepting at one end; and finally, those at the extreme of the fibre were agitated and waved to and fro as if to get loose, which they did from time to time, and, assuming a curved form, revolved each upon its axis and swam away with amazing velocity. There was no doubting, after this, the identity of the Vibrios and the muscular fibrillæ; but I thought such a strange phenomenon ought to have a second witness to vouch for it, and therefore went for the best that could be wished for, Professor Agassiz. I simply placed the preparations before him, and, without giving him the least hint of the origin of the muscle, I was pleased to have him rediscover what I had seen but fifteen minutes before.

The number of ultimate cellules in a moving string varied from two to fifty; the greatest number of strings were composed

of only three or four, often six to eight, and rarely as high as fifty. Very rarely the fibres split longitudinally, and in such instances the fibrillæ were most frequently long, and moved about with undulations rather than a wriggling motion. A single ultimate cellule, when set loose, danced about in a zigzag manner; but whenever two were combined, the motion had a definite direction, which corresponded to the longer diameter of the duplicate combination; and if only three were combined, the spiral motion was the result of their united action. What it is that causes these cellules to move I do not profess to know, but certainly it is not because they possess life as independent beings. This much is settled, however, that we may have presented to us all the phenomena of life, as exhibited by the activity of the lowest forms of animals and plants, by the ultimate cellules of the decomposed and fetid striated muscle of a Sagitta. I do not pretend to say that everything that comes under the name of Vibrio or Spirillum is a decomposed muscle or other tissue, although I believe such will turn out to be the fact; but this much I will vouch for, and will call on Professor Agassiz to witness, that what would be declared, by competent authority, to be a living being, and accounted a certain species of Vibrio, is nothing but absolutely dead muscle.

ART. XIV.—*Biographical Sketch of Professor Denison Olmsted;* by Rev. C. S. LYMAN.

IT is with deep sadness that we record the death of Professor DENISON OLMSTED, for thirty-four years the honored incumbent of the chair of Natural Philosophy and Astronomy in Yale College. He died at his residence in New Haven, after a few weeks illness, on the 13th of May, 1859, in the sixty-eighth year of his age.

Besides this brief record, it is fitting that this Journal, to which Professor Olmsted has been a contributor from its commencement, should preserve, as a further tribute to his memory, such a sketch as our limits will permit of his career as a man of science. For a full analysis of his life and character in the several relations, public and private, which he was called to fill, we neither have room, nor is this the appropriate place. And such a presentation, we are happy to add, is rendered the more unnecessary by the very complete and admirable commemorative Address of Pres. Woolsey,* in which is given a just and discriminating estimate not only of Prof. Olmsted's scientific

* New Englander for August, 1859.

labors, but, more fully, of his successful career as an instructor, and of his well-balanced and exemplary character as a man and a christian in all the relations of life. It will be our purpose, therefore, in this sketch, to contemplate Prof. Olmsted, chiefly, as a teacher and cultivater of science.

He was born in East Hartford on the 18th of June, 1791,—the fourth child of Nathaniel Olmsted, a respectable farmer, who was a descendant of James Olmsted, one of the first settlers of the colony of Connecticut. His mother, a daughter of Denison Kingsbury of Andover, Ct., was a woman of most exemplary christian character, and to her (his father having died when he was about a year old) he was indebted for that excellent religious training, the fruits of which were exhibited in all his subsequent life, and for which she found herself rewarded, even to extreme old age, by a depth of affection and veneration on his part such as few mothers can inspire.

In Farmington, to which town his mother removed, on her second marriage, when he was about nine years old, he attended a district school for several winters, having his home for that purpose in the family of Gov. Treadwell. This excellent man, becoming interested in the boy for his amiability, intelligence, and other promising traits, took pains to instruct him privately during the long evenings, especially in arithmetic, which was not then taught in the common schools; and so befriended him, in this and other ways, that in after life Prof. Olmsted ever cherished his memory with the deepest affection and gratitude, and at a later period, embodied his estimate of his benefactor in an elaborate memoir, published in the American Quarterly Register for 1843.

At the age of sixteen, when he had been for some time employed in a country store, in which a son of Gov. Treadwell was one of the partners, he made up his mind to obtain a liberal education; and after pursuing his preparatory studies, first at an excellent school kept by James Morris at Litchfield South Farms, and afterwards under Rev. Noah Porter, pastor at that time, as now, of the church in Farmington, he entered Yale College in 1809, when Dr. Dwight, to whom he afterwards became strongly attached, and who exerted a very decided influence on his character, was in the zenith of his reputation and power. Young Olmsted was a diligent and successful scholar, and at his graduation in 1813, took the rank of an orator in a class of seventy, when only ten received that honor.

On leaving college, Mr. Olmsted became a teacher in New London, taking charge of the "Union School," so called,—a private institution for boys. In 1815 he was appointed to a tutorship in Yale College, and while filling this office, commenced the study of theology in a class instructed by Dr. Dwight, with

to entering the ministry. In about a year, however, his
l instructor was removed by death, and Mr. Olmsted
d his affection for his memory by an appreciative memoir,
was published in the Port Folio for November, 1817.
/hile his experience and observation as a teacher, not only
ege and in New London, but in Farmington also, where,
age of seventeen, he taught a district school, appear to
.wakened in his mind a deep interest in the subject of
ion, and a desire to make some effort for the improvement
schools of his native state. In an oration "on the state
cation in Connecticut," which he delivered in 1816 on
his Master's degree, he sketched the outlines of a plan,
ıl with himself, of what he termed a "seminary for school-
s," to be supported by the State;—an idea since so hap-
alized in our Normal Schools.

his aims in this direction were terminated, as well as his
gical studies, by his appointment in 1817 to the chair of
stry in the University of North Carolina, upon the duties
ich he entered after a year spent at New Haven in special
ation under the private instruction of Prof. Silliman. At
l Hill he not only discharged successfully the duties of his
sorship, (which, besides chemistry, then included, as in
other colleges, mineralogy and geology,) but, during his
ıce there, he was also employed by the State to make a
of its geology and mineral resources;—a circumstance
ore worthy of notice, as this was the first enterprize of the
ccomplished under the auspices and at the expense of any
States. The project was first laid by Prof. Olmsted, in
before the Board of Internal Improvements, with the offer
form the entire work himself, gratuitously, and the modest
tion of an appropriation by the Board of "*one hundred*
, to be afterwards renewed or not at the pleasure of the
," to defray his necessary expenses in traveling. This
sition, however, the Board declined, and the survey was
ards made under the direction of the State Board of Ag-
ıre. To this Board Prof. Olmsted addressed his Report,
was published in two parts, in 1824 and 1825, filling in
out 140 pages octavo; so unpretending was the prototype
numerous and ponderous volumes of scientific research
have since been published by so many of the States. This
, regarded especially as the gratuitous vacation-work of a
individual, and in view of the state of geological science
s country at the time, must certainly be looked upon as
ıble in the highest degree both to the enterprise and the
fic ability of its projector; and it has undoubtedly been
at benefit, not only to the State which authorized it, but
country and to science generally, by the stimulus which

it afforded to similar enterprises in other States. Prof. Olmsted gave the first geological description of the Deep River Coal Field, and of the Red Sandstone accompanying; and referred the strata correctly to the same age with that of the Richmond coal beds and the Connecticut River Sandstone.

While at Chapel Hill, Prof. Olmsted also began researches to determine the practicability of obtaining illuminating gas from cotton-seed—a waste material so abundant in cotton-growing districts as to be an important product of agriculture if capable of being put to any valuable use.

These researches, however, were broken off, as well as his further cultivation of chemistry and geology, by his call, in 1825, to the professorship of Mathematics and Natural Philosophy in Yale College, left vacant by the death of Prof. Matthew R. Dutton, who himself, only three years before, had succeeded the lamented Fisher, Prof. Olmsted's classmate and intimate friend, whose brief but brilliant mathematical career was so sadly terminated by shipwreck in 1822, when on his way to Europe for the purpose of study.

Prof. Olmsted came to this new chair, it will be noticed, after he had spent some of his best years in one requiring attainments and mental culture of a widely different cast. But though lacking somewhat, as he was himself aware, in that special preparation which a devotion of those years to the higher mathematics and the more abstruse investigation of physics might have given him, he nevertheless applied himself with such zeal to his new duties as to overcome in great measure the difficulties he encountered, and approve himself a successful instructor in the branches committed to his care. The department of mathematics, however, in accordance with his own wishes, was in 1835 made a separate chair, and assigned to the able and promising, but short-lived Prof. Anthony D. Stanley, while Prof. Olmsted retained his favorite branches of natural philosophy and astronomy. In these he continued to give instruction down to his last illness, a period in all of thirty-four years.

When he came to New Haven he discovered a sad want of suitable text-books in his department. Enfield's Philosophy, which had held its place in our colleges for many years, was full of inaccuracies and far behind the existing state of science. And the series of text-books then recently prepared by Prof. Farrar of Cambridge, chiefly translations from French authors, were, besides other objections, both too extensive and too difficult for the majority of American students at that period. This recognized want Prof. Olmsted successfully met by the preparation of his larger work on Natural Philosophy, which was first published in 1831, in two volumes octavo. This work, though in parts professedly a compilation or abridgment, as in mechanics,

he treatise of Bridge, and though excluding the higher natics, which were not then taught in our colleges, is yet terized by so many excellencies of form and arrangement, the whole is so well adapted to the wants of the great ty of students, that it has from the first been received ivor by the public, and having passed through many edi- ontinues to be very extensively used in the colleges of the l States. If the rapid progress of research and discovery ts first publication has rendered some changes necessary ot it to the present state of science and to the higher stand- education in our colleges, a new and thorough revision of ole work, which its author was about to enter upon at the f his death in connection with Prof. Snell of Amherst and Iewton of Yale College, and which, it is understood, these nen are now carrying forward, will be likely to render it as ible hereafter as it proved to be when originally published. abridgment of this work, called the "School Philosophy," iblished in 1832, for the use of high schools and acade- nd has already, it is said, passed through more than a d editions. A still smaller work, entitled "Rudiments of il Philosophy and Astronomy," was issued in 1842, and ted to pupils in elementary schools. This little work has arough some fifty editions, and on account of its clearness mprehensiveness, has been adopted as the text-book on ubjects for use in institutions for the blind, an edition for irpose having been printed in raised letters, in large quarto is early as 1845.

. Olmsted's text-book of Astronomy for colleges was pub- in 1839 in one volume octavo. It is characterized, in the by the same qualities as his other books, and has found l favor, it is believed, among the teachers of that science. ridgment for schools was published soon after the original Still another book on the same science, called "Letters ronomy," purporting to have been written to a lady, was ed by Prof. Olmsted as a reading book at the request of ssachusetts Board of Education, and published in 1842. des instructing in astronomy by text-book, Prof. Olmsted ed annually to the two upper classes in college three s of lectures, one on natural philosophy and optics, one onomy, and another on meteorology. These he prepared nuch labor, and by frequent revision, endeavored to adapt rapid progress of scientific discovery. They were charac- by fullness, clearness and method, and sometimes by elo- . The course on meteorology was, perhaps, on the whole, st attractive and useful.

he subjects of storms, auroras, and shooting-stars, he took interest. A new theory of Hail-storms was published

by him, in 1830, in the American Journal of Science,—ascribing their origin to the sudden mingling of large bodies of hot and humid air with air extremely cold, by which the vapor of the former would be rapidly condensed and congealed into hail; which effect would be produced whenever, by means of opposing winds, whirlwinds, or other atmospheric disturbance, hot air should be carried above the line of congelation or cold air brought below it. This hypothesis, though it has never obtained the celebrity of the ingenious, but improbable, electrical theory of Volta, is yet, perhaps, as plausible as any, or at least is sufficiently so to warrant its author in his steady adherence to it, especially if we consider that such is the intrinsic difficulty of the subject as to compel the acutest physicists to confess that no satisfactory theory has yet been proposed,—hailstorms being characterized by Pouillet as among the most formidable of scourges to agriculture, and the most perplexing of phenomena to meteorologists.

In respect to the great storms of our Atlantic coast, and similar ones elsewhere, he adopted in the main, the rotary theory of Mr. Wm. C. Redfield, whom he early encouraged in the development of his views on this subject, and for whom he cherished a sincere attachment, which led him, after the death of his friend, to prepare the eulogium which he delivered before the American Association for the Advancement of Science, at its meeting in Montreal. In this address Prof. Olmsted thus defines his own position in respect to Mr. Redfield's views. "While from the first I have heartily embraced Redfield's doctrine that ocean gales are progressive whirlwinds, and have further fully believed that he had established their laws or modes of action on an impregnable basis, a regard to truth and candor obliges me to say, that I have never been a convert to his views respecting the ultimate causes of storms, especially so far as he assigned for these causes what he denominates the 'diurnal and orbitual motions of the earth,' but his notions on this point have always appeared to me unsatisfactory."

The phenomena of the northern lights, such remarkable exhibitions of which occurred in 1835 and 1837, were watched by Prof. Olmsted with intense interest, and one of his latest and most elaborate memoirs is that "On the Secular Period of the Aurora Borealis," published in 1856, in the eighth volume of the Smithsonian Contributions. In this paper, rejecting the electrical and magnetic hypotheses, and others which ascribe the origin of the aurora to terrestrial causes, he advocated the doctrine of their cosmical origin, deriving their materials from some supposed nebulous body traversing the planetary spaces, and assigning to the phenomena a secular period of about sixty or sixty-five years. This view, it must be acknowledged, has

found, as yet, little favor among men of science. But, whether it prove ultimately to have any foundation in truth or not, Prof. Olmsted deserves very great credit for the unwearied diligence with which he has collected and recorded the facts, and for the earnestness with which he has called the attention of philosophers to this most interesting problem in physics.

But Prof. Olmsted is most widely and favorably known to the scientific world by his papers, published chiefly in the Journal of Science for 1834, on "meteoric showers," or showers of shooting stars. His interest in the subject was first awakened, like that of many others, by the very remarkable phenomena of the morning of November 13th, 1833, when, in all parts of the United States, myriads of these meteors, especially between the hours of two and five o'clock, were seen falling in a brilliant and continuous shower through the heavens. Prof. Olmsted saw this magnificent display, indeed, not in its maximum grandeur, but only the portion of it which occurred after half past five o'clock, when his attention was first called to it by a friend. Yet observing it with the eye of a philosopher, he noted with care its most important features, and collecting at once all the observations he could obtain from various quarters, he made a careful classification and analysis of the facts, which he presented in two successive numbers of the American Journal of Science for 1834.* While preparing this paper he was led to entertain the idea that these meteors had a cosmical rather than a terrestrial or atmospheric origin, and at the close of his article, stated it as his general conclusion, "That the meteors of Nov. 13th consisted of portions of the extreme parts of a nebulous body, which revolves around the sun in an orbit interior to that of the earth, but little inclined to the plane of the ecliptic, having its aphelion near to the earth's path, and having a periodic time of 182 days, nearly."

Prof. A. C. Twining, then at West Point, from his own and other independent observations, arrived substantially at some of the same conclusions, especially in respect to the cosmical origin of the meteors, though apparently with a less degree of confidence, as appears from his own candid remark in his very able article on the subject in the twenty-sixth volume of the Journal of Science, "That he is not able, as yet, to adopt even his own inferences respecting the cause, in any other way than as *conjectural and highly credible.*" Both he and Prof. Olmsted, however, clearly recognized the leading fact, which was decisive of the question of cosmical origin, namely, the identity of the point of apparent radiation of the meteors with the point in the heavens towards which the earth was then moving in its orbit, and the names of both must consequently be associated, in the minds of those who read their articles, with the theory which both so essentially contributed to establish.

* Vol. xxv, No. 2, and Vol. xxvi, No. 1.

Prof. Olmsted, however, has from the first been chiefly associated in the public mind with this theory of meteors,—partly, perhaps, from the greater confidence and fullness of explanation with which he propounded it, and partly from his prominent position before the public in an important chair of science. The theory, indeed, in the precise form in which he originally stated it, has never in all its details obtained general currency, and was even for a time wholly rejected or regarded with much incredulity by many distinguished men of science, yet in its leading features of cosmical origin and periodicity he had the satisfaction of seeing it remain unshaken, and receive the approbation and support of the leading physicists of the day. A broader generalization of facts, especially those gathered by Mr. E. C. Herrick, from the records of meteors in preceding ages, soon brought to light other annual periods of their return besides that of November, particularly those of April, August and December. This modification, however, did not affect the main point of the hypothesis.

It has been said, indeed, that Prof. Olmsted was anticipated in this theory by Chladni; and Humboldt, who in several passages of the Cosmos, speaks of the researches of Prof. Olmsted in complimentary terms, refers to them in one place, not as having originated the hypothesis, but as "a brilliant confirmation of the cosmical origin of these phenomena,"* ascribing to Chladni the credit of the theory itself. But besides the fact that, so far as appears, the cosmical hypothesis of Chladni pertained especially to aerolites and their associated fireballs, and did not definitely include showers of shooting stars, and the further fact, that the idea of the cosmical origin of this whole class of meteors had been suggested in general terms by many other philosophers even including Anaxagoras, we may remark, without claiming for Prof. Olmsted the merit of priority, that his conclusions were unquestionably original with himself, and entirely independent of any results of preceding investigations. Whatever form in respect to its details, the theory may assume in the light of future researches, to Prof. Olmsted clearly belongs the merit of having discerned and demonstrated its leading truth, and he deserves for what he has done, all the credit that has been accorded to him by European savans. Humboldt, Biot, Olbers, Encke, and others, adopting substantially the same views, have fully recognized his merits and spoken of his investigations in complimentary terms.

Prof. Olmsted gave much attention also to the subject of the zodiacal light, and in papers published in the Journal of Science and in the Proceedings of the American Association, has endeavored to establish an identity between its source and that of the November meteors. The same idea has received the sanction

* Cosmos, vol. i, p. 118, Harper.

upport, also, of M. Biot, who assigns to Prof. Olmsted the t of its authorship.

will be seen, from the brief account we have given, that Olmsted was inclined to adopt theories very similar to each , to explain the phenomena of shooting stars, of auroras, of the zodiacal light—if not, indeed, to ascribe them all to ind the same origin. But if, in the case of auroras or the ical light, his speculations shall fail to be confirmed, it be remembered that they were for the most part thrown by him only as conjectures, and that he himself disclaimed ing his theory of meteors at all responsible for their sound- ; and furthermore, that it is a thing by no means of rare rrence among men of science that a successful theorizer has tempted by success to stretch the application of his theory nd its legitimate limits.

ie want of a proper observatory and of suitable instruments ew Haven, prevented Prof. Olmsted from giving to prac- astronomy as much attention as he might otherwise have . Of the Clark telescope, however, at that time the best in ountry, he made as good use as his other engagements and rretched position of the instrument would allow, in showing s pupils such celestial phenomena as admitted of simple in- ion; and with this instrument in 1835, he, with Prof. Elias iis, then a tutor in the College, succeeded first of American vers in obtaining a view of Halley's comet, then so anx- y looked for both in this country and in Europe. This iency of astronomical instruments Prof. Olmsted was always ous to remove, and at various times efforts were commenced, iich he zealously participated, to establish an observatory. many difficulties arose from time to time, especially in the er of raising funds, and he never enjoyed the satisfaction of g so desirable an object accomplished.

teaching science, Prof. Olmsted by no means restricted him- to theoretical instruction, but, both in the lecture-room and pular articles and addresses, endeavored to render science ctive and useful to all, by pointing out its practical applica- . He gave much attention to the means of protecting houses lightning, the warming and ventilation of buildings, and like practical problems, as they were brought to his notice, iently contributing articles on such topics to the papers of lay, and often, on the occurrence of any special phenomena ng within the range of his department of science, favoring ublic with an appropriate discourse. He was the inventor i excellent stove which bore his name, the patent for which me to him at first, it is understood, a source of some pecu- y profit, at a time when his insufficient salary rendered an ase of income particularly acceptable, but afterwards, from

causes not connected with its merits, ceased to be remunerative. A useful preparation of lard and rosin for lubricating machinery was also invented by him some years ago, but never patented, and it has since, it is said, become an article of successful manufacture.

In forming our estimate, on the whole, of Prof. Olmsted's scientific character, we must bear in mind that he himself always regarded it as his more appropriate sphere of effort, in the circumstances in which he was placed, not so much to *cultivate* science as to *teach* and *diffuse* it. Teaching, indeed, was his chosen and ever-cherished work, and the one for which by temperament, talents, training and attainments, he was peculiarly fitted. His uniform kindness and courtesy of demeanor, and patience in imparting instruction—the excellent moral influence which he always exerted as well by his consistent christian example as by his personal counsels—the genuine friendliness of his disposition, and the unaffected interest which he always manifested in the welfare of his pupils—especially the readiness and fidelity with which he encouraged and assisted any who exhibited special fondness for the studies of his department—will not soon be forgotten by those who enjoyed the benefit of his instructions, and especially by those who were admitted to his closer friendship. Ebenezer Porter Mason was a pupil whose brilliant and versatile talents, and especially his rare attainments and promise in mathematics and astronomy, awakened in his instructor at once the liveliest and most affectionate interest; and on the death of this remarkable genius at the early age of twenty-two, Prof. Olmsted paid a tribute not less to his own kindness of heart than to the memory of his friend, in writing the excellent memoir of his life which was published in a duodecimo volume in 1842.

Besides the writings which have been named, Prof. Olmsted published, at different times, many elaborate articles of a scientific or literary character, in the leading periodicals of the day, particularly the American Journal of Science and the New Englander. He was especially fond of biographical composition, and his memoirs of Dr. Dwight, Sir Humphry Davy, Gov. Treadwell, Eli Whitney and Wm. C. Redfield, may be mentioned as favorable examples.

In the later years of his life, Prof. Olmsted saw much affliction. Besides his first wife, four sons, grown to manhood, graduates of college, and giving fine promise of usefulness and distinction in literature or science, were one after another taken from him, —filling his home with grief yet not destroying his cheerfulness or composure of mind. But he has now gone to his rest, and not alone his remaining family, but the wide circle of his friends and former pupils will cherish with deep affection his honored memory.

Art. XV.—*Correspondence of Prof. Jerome Nicklès of Nancy, France, dated April 17th*, 1859.

Academy of Sciences.—Distribution of Prizes.—On the 14th of last March the Academy of Sciences held its annual public meeting. We have more than once spoken of these annual sessions and shown them to be generally void of result, a fact for which the Academy itself, which accomplishes so poorly its mission, is to blame. It has been this year as in preceding years, and we are compelled to repeat the truth: if we were to judge of the progress of science by the prizes awarded, we should infer that nothing new had been accomplished in the departments of mathematics, mechanics, physics, chemistry, geology, mineralogy, botany, &c., —we could almost say in all departments of experimental science. Happily it is not so, and our readers have been able to judge by our correspondence for the years 1857 and 1858, that in Europe as in America, men of science have well employed their time and their strength to the great advantage of science and humanity.

Astronomical Prize.—The only section which every year awards a prize, is that of astronomy, in behalf of which the astronomer Lalande established a fund for the purpose of granting a medal to the person who in France, or elsewhere (the members of the Institute excepted), should have made the most important observation or prepared a treatise or work contributing most highly to the progress of the science. Not willing to pronounce on this latter point, the Academy has divided the prize between MM. Goldschmidt of Paris, Laurent of Nismes, Searle of the Observatory at Albany, N. Y., Tuttle of Cambridge, Mass., Winnecke of Bonn, and Donati of Florence. The following is an extract from the report.

The planet Nemausa was discovered on the 22d of January at Nismes by Mr. Laurent, and the planet Pandora on the 10th of September by Mr. George Searle, assistant in the Observatory at Albany in America. The names of these two savans are now inscribed for the first time in the list of observers who, within a dozen years, have enriched astronomy by discoveries of asteroids.

The planet Calypso, discovered on the 4th of April at the observatory of Bilk by Mr. Luther, is the seventh the knowledge of which is due to this skilful astronomer.

The two planets, Europa and Alexandra, were discovered at Paris the 4th of February, and the 10th of September by Mr. Goldschmidt, that successful explorer of the skies, who, without having to meet the ordinary responsibilities of an astronomer, devotes himself continually, through love for science, to the most laborious researches. It was at first thought that he had rediscovered, on the 9th of September, 1857, the planet Daphne; but Mr. Schubert of Berlin soon showed this to be a mistake, proving that the planet was a new one. This planet, which by the date of its discovery is the 47th of the group, increases to *twelve* the number made known by Mr. Goldschmidt.

Among the comets of the year 1858, there are two whose periodicity is well established, and one that presented during its long and brilliant

display phenomena of great interest bearing on the physical theory of comets.

Of the three comets discovered at Cambridge in America by Mr. Tuttle, the first on the 4th of January, the third on the 2d of May, and the sixth on the 5th of September, the first is of peculiar interest, as its elements are recognized as identical with those of the second comet of 1790 discovered by Méchain. Mr. Bruhns of Berlin, who discovered this comet seven days after Mr. Tuttle, has compared a great number of observations made up to the month of March in Europe and in America, and has deduced from them an elliptical orbit of 13·66 years. The comet discovered on the 4th of January by Mr. Tuttle has therefore returned four times since 1790 without having been seen.

Statistical Prize.—Of a number of prizes for statistics we notice an "honorable mention" decreed to Mr. Bérigny of Versailles for a work on the question, "Is there any connection between germiuation and the changes of the moon, or between its phases and human generation?" This statistical treatise contains a list of 30,958 births according to the civil state-registers of Versailles, and extending over forty years. The results are negative; that is to say, on the authority of the civil register of Versailles it can be declared that the moon does not possess, like the sun, the privilege of influencing the march of human generations.

Prize for Experimental Physiology.—The great prize for Experimental Physiology was awarded to Mr. Jacubowitch for his treatise on the *Internal structure of the brain, and on the spinal cord of man and animals.* According to the statement of the commission this work contains results of great importance to histology, physiology, and comparative anatomy. The report made by Mr. Claude Bernard concludes thus. "In recapitulation, Mr. Jacubowitch has taken up one of the most difficult problems in physiology and anatomy, that of the texture of the nervous system and of the different constituent elements with reference to determining their physiological importance. This author has recognized and described three peculiar forms of nervous cellules in their relations to one another and to three kinds of nervous fibres. He has determined the exact arrangement of these nervous histological elements in the spinal cord, the medulla oblongata, and the brain; he has indicated the points of the nervous centres in which these cellules or fibres group themselves, accumulate, mingle, separate, appear or disappear. These anatomical researches, made not only in man but also in four classes of vertebrate animals, are of great importance to physiology."

A second prize for Experimental Physiology was divided between Mr. Leuhossek of Warsaw and Mr. Lacaze-Duthiers, Professor in the faculty of sciences at Lille; the first for his "Etudes Anatomiques" on the central nervous system. These are researches in microscopic anatomy having numerous relations to physiology. The method employed by Mr. Leuhossek in his researches is the method of slices in different directions; the parts of the nervous system were not hardened by chromic acid, but only by alcohol, and the slices were rendered transparent either by acetic acid or some other convenient substance.

The labors of Mr. Lacaze-Duthiers have contributed largely to the progress of most of the branches in the history of acephalous mollusks;

commission has bestowed its attention principally on the experiments observations of this naturalist relating 1st, to the circulation of the ishing fluids in the Dentalia; 2d, to the developments of the respira- apparatus in mussels (Mytili); and 3d, to the structure of the urinary ds and the organs of generation of a considerable number of other usks.

he Bréant Prize.—We have already several times spoken of the of 100,000 francs instituted by Mr. Bréant in favor of the person should discover a mode of medical treatment which would cure the ra in the majority of cases, or who should point out satisfactorily the es of Asiatic cholera so that by removing these causes, an end would ut to the epidemic; or lastly, to the person who should discover a in preventive of it, as evident, for example, as that of vaccination for l-pox.

reseeing that this prize of 100,000 fr. would not be awarded very , Mr. Bréant grants the interest of this sum to the person who shall promoted the progress of science as regards the cholera or any other emic malady.

is year the Academy of Sciences awarded a prize of 5000 fr. to Doyère for his experiments on the composition of the air expired ictims of the cholera, and the temperature of the body of these nts during the last moments of life. Mr. Doyère has proved the fol- ng points: 1st, the more severe the attack of cholera, the larger the unt of oxygen in the air expired; 2d, the proportion of carbonic thrown out by cholera patients is very inconsiderable; 3d, notwith- ling the diminution of the activity of the respiratory functions, the erature of the body increases till it reaches the point of 43° C. ° F.) in the region of the armpit.

is but justice to state that of these three results, the first was an- ced in 1832 by Mr. Rayer; the last was proved in 1830 by the French icians who went into Poland to study the cholera; and it was after- s verified in England and in the United States.

oreover neither the second nor the third facts are peculiar to the vic- of cholera. As for the second, Dr. Malcolm demonstrated in 1844, in typhus fever a less quantity of carbonic acid escapes from the s than in the normal state of the body, and furthermore, Mr. Doyère bserved the same fact in respect to persons affected with typhoid and with acute pneumonia. As far as concerns the latter fact, y authors have noticed a rise of temperature in the last stages of et and yellow fever, as in cases of cholera, and Mr. Doyère has seen ame thing in typhoid fever.

iscussion upon the nature of simple bodies.—The discussion men- d in our last communication, and which was started by a paper read Ir. Despretz, has since been renewed, and it has been watched with itmost interest by all who are engaged in the physical sciences. otless it has not changed the opinion of either Despretz or Dumas; this is well for the latter chemist at least, for all competent observers d Dumas as representing in this case the cause of progress.

hile the discussion has been useless in this—that it has only brought leas which have been current in science, and in the elaboration of

which Dumas has had so large a share, it has had an important scientific bearing, since it has contributed to the establishment of these very ideas, and has compelled Dumas to put in a precise form his scientific opinions on the unity of matter and the intimate nature of simple bodies.

We give a brief notice of the discussion, as it is one which will without doubt leave its trace on the records of science.

Dumas having declared that the experiments which Despretz had just published were neither necessary in the actual state of science, nor yet decisive, Despretz replied in his turn, criticizing the ideas of Dumas on the unity of matter. According to him there is not a sufficient analogy between the radicals of organic chemistry and the simple bodies of mineral chemistry. The first are decomposed by heat, and converted by oxygen into water and carbonic acid. These organic compounds thus disunited can never be again re-composed. It is well understood to be quite otherwise in respect to the elements of mineral chemistry. From this Mr. Despretz concluded that there is not only no analogy, but that there is a complete contrariety, between the elements of organic and inorganic chemistry; in a word, as far as he can discern, science furnishes no indication favoring a belief in the decomposition of the bodies considered simple, even by the aid of new forces. On the contrary he thinks he has demonstrated that the metals and metalloids are simple bodies. We have already seen by what processes he thinks he has arrived at this conclusion: he returns to the subject now to show in what respect his experiments are new, and says: "all chemists have ignited iron and platinum to a white heat, but no chemist to our knowledge has ignited these metals in a barometric vacuum for the purpose of ascertaining whether any gas was disengaged; and this is my experiment."

"Nothing is disengaged under the action of heat, or of a spark from a powerful induction apparatus. This negative result is of a nature to astonish the partisans of the theory of Dr. Prout, if any exist. According to this hypothesis, iron should retain about 80,000 and platinum 200,000 volumes of hydrogen gas condensed into only one volume. How can we suppose that a condensed gas could resist the test to which iron and platinum are subjected in my experiment? Is there a single fact in physics and in chemistry which authorizes such a supposition? In my process the disengagement of $\frac{1}{20}$th of a cubic centimetre of gas would have been readily appreciable. To this slight weight the most delicate chemical balances would have been insensible."

The reply of Dumas is briefly as follows: "I demand of Mr. Despretz why he expects the metals to resolve themselves into gas? why is it necessary that the primary elements of bodies should be gaseous? As regards the analogies between organic and inorganic chemistry, which are denied by Mr. Despretz, I ask where is the chemist who would not unite in one group cyanogen and chlorine, bromine and iodine? Where are the differences between these two sets of substances? Do they not blend in all their chemical affinities? Does not the analogy between them extend even to a similarity of atomic volumes? It is true cyanogen has been decomposed while the others have resisted decomposition; but he is greatly mistaken who believes that the discovery of cyanogen did not suggest doubts to the minds of chemists, and to Gay Lussac himself, on the nature of chlorine."

Is not the same the case with ammonium and the radicals of the ms? Do not these radicals furnish oxyds, chlorids, sulphurets? Do their oxyds, acting the part of bases, resemble potassa and soda so ngly as even to mislead? Have we not in the combinations of these cals the same system as in inorganic chemistry? Who is the chemist hom these discoveries succeeding one upon another, have not suged doubts concerning the nature of the metals?"

In a word, the efforts of modern chemists for forty years, efforts withparallel from the first beginning of chemistry as a science, in which uch perseverance and so much courage have been expended, have lted in proving that organic chemistry is made up of substances ch are subject to the very same laws with which Lavoisier enchained ganic chemistry, and subordinated to the same scheme through all roducts." It was Lavoisier who, on tracing out the route for us to w, more than seventy years since, defined organic chemistry as the nistry of *compound radicals*, and mineral chemistry the chemistry of ecomposable radicals."

umas then refuted one after another the facts brought forward by antagonist in proof of his view. "If Mr. Despretz thinks that by lling mercury, zinc, or cadmium, these substances can be decomposed, orgets that alchemists and the arts long ago threw light on this point. e confounds with the decomposition of a simple body the analysis of ixture, I regret it, but I remain convinced that there is not the slightonnection between the successive separations and the decomposition imple bodies; that there is nothing in common between those fortu concentrations to which we owe the discovery of iodine, cadmium, ium and bromine, and a philosophical discussion concerning the ciple of the unity of matter."

umas presented the following conclusions: "1st. It appears to me e and more probable that the equivalents of simple bodies are multiof the same unit; 2d, that the radicals of mineral chemistry behave e same way as the radicals of organic chemistry; 3d, that it is imble to prove that bodies reputed simple are undecomposable; 4th, if, even at the present time, simply by employing forces and means ady known, it is easy to contrive processes more powerful than those ch Mr. Despretz has employed for the purpose of accomplishing this mposition, I regard it as my duty to affirm anew that in my opinion e processes, though more rational, will not probably be more effec-."

iscussion on cellulose and ligneous fibre.—While this discussion on question of simple bodies, of which we have spoken, was being caron, and that concerning spontaneous generation so spiritedly agitated to this present hour (see our last communication), another important tion was handled before the Academy of Sciences; it was concerning probability of the existence of only one, or of several kinds, of celse. Payen was an advocate of the first opinion, Fremy of the nd. Judging from the action produced upon ligneous tissues by weitzer's reagent (see our last communication but one), Fremy admits ast two species of cellulose, for he has seen paper and textile fibres eneral dissolve in ammoniacal oxyd of copper, while elder-pith and eous fibre in general resist its action.

To Mr. Payen this difference seemed only an apparent one; he believed that in this latter case, the cellulose is incrusted with gum and foreign matters which hinder the solubility; also the pith of the elder which is insoluble in Schweitzer's reagent, becomes soluble in it when it has been previously treated with a weak acid such as dilute chlorohydric acid. Mr. Fremy supposed that the chlorohydric acid does not act as a solvent of foreign matters, but that it converts one variety of cellulose into the other variety, in the same way, for instance, as an acid converts cane sugar into glucose.

We need not speak of the different phases of this discussion, for it is not yet settled. According to Fremy, we must admit at least two kinds of cellulose offering the same percentage composition but differing from each other in their chemical properties and capable of being brought into the same state by the most diverse reagents, such as mineral acids, organic acids, potassa, ammonia, etc. In order to prove that the differences in the properties of cellulose are due to the state of the organic substance itself and not to the presence of mineral substances, Fremy has had recourse to the action of heat. In exposing vegetable pith, which is insoluble in the cupreous reagent, to the action of a temperature not exceeding 30°, and maintaining it at that point for several hours, he has seen that substance become soluble in the above reagent. He arrived at an analogous result by keeping the cellular tissue of pith for twenty-four hours in boiling water.

Furthermore, he has remarked that this change takes place only in the organic substance of the tissue, for the proportion of mineral matter remained the same in both cases, and the tissue which had become soluble in the cupreous reagent, left after its calcination a mineral network, reproducing exactly the form of the vegetable cellules, which same thing happens to tissues not modified by either dry or humid heat.

In order to distinguish between these two kinds of cellulose, Fremy calls *para-cellulose* that which *does not dissolve immediately* in the cupreous reagent. He reserves the name cellulose for that which *dissolves directly without previous treatment. Cellulose* is found in cotton, fibres of bark, cellular tissue of fruits or of roots. *Para-cellulose* constitutes principally the pith of trees, ligneous fibre, the cellular tissue of the epidermis, &c.

This is not Payen's opinion; the experiment of Fremy, quoted above, does not appear to him to prove that the pith of the elder is of an isomeric composition with the cellulose of textile fibres; for in Payen's view it is not only the fact that foreign substances in the form of incrustations oppose the solution of the cellulose in Schweitzer's reagents, but infinitely minute bubbles of air which are condensed there have the same effect to a certain point, in forming a protective envelop; according to him the pith of the Æschynomene, insoluble in Schweitzer's reagent, becomes soluble in it by keeping it in a vacuum in the cold under an exhausted receiver and afterwards plunging it under water; the liquid is then placed in a refrigerating mixture. After congealing, the pith has become to a great extent soluble; there remains a residue of 43 per cent containing 15 per cent of mineral substances. These mineral substances according to Payen prevent the complete solution of the cellulose. The

ame is the case with cortical fibres before their purification; so also emp just obtained from the flax-plant resisted solution for more than ix hours, and the portions not dissolved preserved their fibrous form.

Incrusting matter; Dead cotton.—All these questions have recalled attention to an old paper by Mitscherlich on the composition of vegetable ellules, cellules essentially formed of cellulose, and of a substance analogous to cork, a suberic material capable of yielding suberic acid and also uccinic and nitric acids. The most delicate vegetable fibres are covered ver with this slender coating of suberic matter; it is on this account hat fresh cotton is with difficulty moistened with water, while it is at nce decomposed if this coating of suberic matter is removed by the acion of chlorine.

Such at least is the opinion of Mitscherlich. It seems however that an mmersion in chlorine is not always sufficient to render this variety of otton capable of receiving color,—the variety perfectly well known mong dyers, who have named it "dead cotton;" it was first described y Daniel Koechlin of Mulhouse, and has since been carefully studied by Walter Crum of Glasgow, whose results are published in the third volme of the Proceedings of the Philosophical Society of Glasgow.

In the opinion of Mr. Walter Crum the dyeing of cotton depends upon a purely mechanical action; chemistry is completely foreign to the subject of fixing dyes upon stuffs; dead cotton is the proof of this; the ibres of this variety of cotton are flattened, while cotton which admits of being dyed is composed of cylindrical fibres; the coloring matter hence can penetrate within these and fix itself there.

This is, as is seen, an opinion diametrically opposite to that of Runge, who is so strong an advocate of the chemical theory that he considers colored cottons as *cottonates;* in this view a faint chamois tint produced by oxyds of iron is called by him *per-cottonate* of iron; another *bi-cottonate;* another still *basic cottonate* of iron.

Mr. Walter Crum declares that the substance of dead cotton has been entirely bleached before becoming flattened; it contains therefore, he says, neither fatty matter nor any impurity capable of hindering the fixing of the coloring matter.

But let us return to the suberic matter whose presence Mitscherlich recognized on leaves and about the exterior of plants. It is over thirty years since Payen showed that the epidermis of plants is covered over with a very thin envelop, containing a fatty matter, some nitrogen and silica. Ad. Brongniart has isolated this pellicle, on which Mitscherlich experimented, by submitting leaves to a prolonged maceration, and has described it under the name of cuticle; and Frémy, who has also just examined it, has recognized in it all the characteristics of a fatty substance which he calls *cutine.* In fact, in contact with boiling potassa, the cutine saponifies and the acid which is produced presents the characters of a fatty acid. This experiment has been repeated with success on the epidermic membranes of leaves, flowers and fruits.

It is easy to develop, ad libitum, this epidermic membrane; it is sufficient, in fact, to experiment on superficial sections of living tissues of leaves, branches, tuberaceous roots, and subterranean stems; at the end of several days the denuded tissues afford characteristic reactions of epidermic membranes.

Transformation of woody fibre into Sugar.—On the occasion of the above discussion Pelouze announced the important results which follow. Cellulose precipitated from its solution in ammoniacal oxyd of copper by a feeble acid, is soluble in dilute chlorohydric acid. Ordinary cellulose is soluble in concentrated chlorohydric acid; water forms with this solution a precipitate of dazzling whiteness; at the end of two days the precipitate ceases to form, and all the cellulose has been transformed into sugar affording the characteristics of glucose.

The transformation of cellulose into glucose can be effected by a prolonged ebullition in water containing a small quantity of sulphuric or chlorohydric acid (some hundredths); paper, old linen, sawdust, and any cellulose more or less pure, can be thus turned into sugar at the end of several hours boiling.

Pelouze thinks that this reaction will become the basis of a new branch of industry—one which has often been attempted since Braconnot succeeded in 1819 in transforming lignine into glucose; he thinks that the transformation would be rendered much more active by operating in a close vessel at an elevated temperature.

Lastly, Pelouze announces that, by treating cellulose with caustic potassa in fusion at a temperature between 150° and 190° C. and dissolving the product in water, a substance can be separated from it by acids which has the composition of cellulose, but differs from it in that it is soluble in the cold in alkalies; it changes into sugar in the presence of chlorohydric acid.

Manufacture of Aluminium.—This manufacture, which is becoming more and more extended, has just taken two steps onward; one, through the publication by H. St. Claire Deville, of a treatise expressly on the subject; the other, by the discovery of a process of soldering. All the labors expended on aluminium up to the month of March, 1859, are recounted by Deville, and as the author and founder of this manufacture, we can feel very certain that the work is not a simple compilation.

As respects the soldering of this metal, until very lately quite imperfect results have been attained. In the Universal Exhibition of 1855, there were pieces of aluminium soldered with zinc or with tin, but this weak solder did not give any solidity. Others have tried to solder with alloys of zinc, silver and aluminium. Mr. Denis of Nancy has noticed that whenever aluminium and the solder melted over its surface was touched with a slip of zinc, the adhesion took place with great rapidity as if a peculiar electric action gave it an impulse at the moment of contact; but this solder also has failed to afford much strength.

At last it has been suggested that the difficulty might be surmounted by previously coating the piece with copper, and then soldering together the coppered surfaces. In order to effect this, the aluminium, or at least the parts to be soldered, are plunged into a bath of acid sulphate of copper. The positive pole of the battery is put in direct communication with the bath, and the pieces to be coppered are touched with the negative pole; the deposit of copper takes place very regularly over the surface of the aluminium. These surfaces thus prepared are soldered in the ordinary way.

All these processes are, as is seen, very imperfect, and they now have only a historical interest, on account of a new and perfect method of

ering just discovered. The inventor is a gilder and silverer of metals, nging to Paris, named Mourey; he has recently announced his pro- in a public meeting of the Société d'Encouragement. The alloy loyed is composed of zinc and aluminium; Mr. Mourey employs five erent varieties of it according to the article to be soldered; the compo- n is as follows:

	I.	II.	III.	IV.	V.
Zinc,	80	85	88	92	94
Aluminium,	20	15	12	8	6

prepare it, he melts the aluminium in a crucible of graphite, the al having been reduced to fragments and added little by little; when mass is in fusion it is stirred with an iron rod while the zinc is added mall quantities at a time; the alloy is still stirred while a little tallow lded to prevent the oxydation of the zinc, and then it is cast in small in- . It is important to avoid too high a temperature lest the zinc should olatilized. It is also important that the zinc should be free from iron. hese five alloys have different points of fusion. Alloy No. 1 is the lest, the others are softer in regular succession.

s for the manipulation of the solder, this comes under technology: Mourey has described it in detail; but it would be going too much specialities for us to cite his account of it, and we subjoin only a facts interesting in a scientific point of view.

he instrument which is used in the soldering, and which is called in ıch "fer-a-souder," ought not in soldering aluminium to be either of or copper, but of aluminium itself; for the soldering alloy adheres on or copper in preference to aluminium. The flux used to facilitate adhesion is made of three parts balsam of copaiba, mixed with one of pure turpentine; the materials are mixed in a porcelain capsule, a few drops of lemon-juice are added to favor the mixture of the two ıs.

his flux is used for thoroughly impregnating the fragments of solder ch are to be employed. It is important to use the blowpipe no longer ı is necessary, to prevent loss of zinc from volatilization.

astly, another novelty of this branch of manufacture is aluminium ıze, which has the proportion of ten parts of aluminium to ninety of per, and has the tenacity of steel. This alloy is now applied on a e scale by J. M. Christoffle; he has noticed that it is of great advantage nake all the surfaces of friction in machinery of aluminium-bronze. s a bearing which had been placed on a polishing lathe making 2200 olutions a minute was found to last eighteen months, while bearings ther different metal, had, in the same circumstances, lasted at most three months. He has employed this bronze with equal success in manufacture of cannon, howitzers, and all kinds of weapons of war. tol-barrels have been thus made which have done good service.

here is as yet nothing very conclusive with regard to this application artillery; but Mr. Christoffle, relying on the tenacity of aluminium- ıze and its resistance to wear, thinks that it will be applicable to manufacture of bronze for cannons. As in France large artillery- es are constructed exclusively in the government work-shops, he has ed for a permit to manufacture at his own expense some pieces of ar- ry, especially such as are most exposed to injury.

ART. XVI.—*Seventh Supplement to Dana's Mineralogy*; by the Author.

List of Works, etc.

FR. VON KOBELL: Die Mineralogie. 248 pp. 12mo, with 4 plates. Leipzig, 1858. An excellent mineralogical manual.

Dr. T. SCHEERER: Löthrohrbuch.—A manual on the blowpipe and blowpipe analysis. 294 pp. 12mo. Braunschweig, 1857.

Dr. A. KENNGOTT: Uebersicht der Resultate mineralogischer Forschungen in den Jahren 1856 und 1857. 272 pp. 8vo. Leipzig, 1859.—Dr. Kenngott is now professor of mineralogy at Zurich, and still finds time to continue his excellent review of the progress of Mineralogy. This volume covers the years 1856 and 1857.

Dr. A. KENNGOTT: Tabellarischer Leitfaden der Mineralogie. 272 pp. 8vo. Zurich, 1859.

Dr. J. SCHABUS: Anfangsgründe der Mineralogie. 250 pp. 8vo. Vienna, 1859.

DELAFOSSE: Nouveau cours de minéralogie, comprenant la description de toutes les espèces minérales avec leurs applications directes aux arts. Tome 1er, 1re et 2e livraisons. Paris, 1858. 8vo, 550 pp., with an Atlas of 16 pages and 20 plates.

DUFRENOY'S Mineralogy.—The 4th volume of the new edition has just been issued at Paris.

Dr. RITTER VON ZEPHAROVICH: Mineralogischen Lexicon für das Kaiserthum Oesterreich.—Mineralogical Lexicon for the Austrian empire. This work is mentioned in the Bulletin of the K. K. geol. Reichs. for 1858, p. 116.

G. SUCKOW: Die Mineralogie in besonderer Beziehung auf chemisch-genetische und metamorphische Verhältnisse der Mineralien. 8vo. 1858.

Dr. J. G. KURR: Album de Minéralogie; in 4to with 22 colored plates. Paris. Firmin Didot frères. 30 fr.—Also translated into English and republished in London.

L. GRUNER: Description géologique et minéralogique du département de la Loire. xx and 779 pp. 8vo, with 7 charts. Paris, 1858.

ROSSI: Nuovi principii Mineralogici. 64 pp. 4to. Venice, 1857.—According to a notice in Jahrb. Min. 1858, 75, the work presents a new classification of minerals, dividing them into 6 classes and their subordinate groups. The classes are, 1. EXOGENS, the gases and water; 2. ENDOGENS, the sulphurets, tellurets, arseniurets, &c.; 3. HYPOGENS, the feldspars and related silicates; 4. PERIGENS, magnesia and aluminous hydrosilicates; 5. EPIGENS, carbonates, sulphates, chlorids, fluorids, &c.; 6. METAGENS, garnet, pyroxene, mica, tourmaline, spinel, &c.

J. H. SCHRÖDER: Elemente der rechnenden Krystallographie, with 73 figures and 5 lithographic plates. Clausthal, 1859.

J. W. BRÜCKE: 118 Stück Gypsabgüsse von naturlichen sowohl einfachen Krystallen.—Models of crystals including especially twins of the feldspars, by J. W. Brücke. Berlin, 1857. A pamphlet of 20 pages containing descriptions of the models.

H. D. ROGERS: The Geology of Pennsylvania, a Government Survey, with a general view of the Geology of the United States, Essays on the Coal Formation and its fossils and a Description of the Coal-fields of North America and Great Britain, by H. D. Rogers, State Geologist, Prof. Nat. Hist. Univ. of Glasgow, &c. 2 vols. 4to of 586 and 1046 pages, with numerous plates, maps, sections and woodcuts.—Prof. Rogers has given in his great work a number of analyses of mineral coal and iron ores, besides describing at length the mines of Pennsylvania.

J. HALL and J. D. WHITNEY: Report on the Geological Survey of the State of Iowa, embracing the results of investigations made during portions of the years 1855, 56, 57. 725 pp. large 8vo, with numerous plates.—Prof. Whitney has published analyses of various limestones, dolomites, iron ores, coals, and treated also briefly of the lead region of the Upper Mississippi.

W. E. LOGAN: Geological Survey of Canada, Report of Progress, for the year 1857. 240 pp. 8vo.—Contains information on the economical minerals of Canada, and a paper on Dolomites by T. S. Hunt.

O. M. LIEBER: Report III. on the Geological Survey of South Carolina. 224 pp. 8vo with maps. 1858.—Contains chapters on the gold and other minerals and rocks of a part of South Carolina.

HANNS BRUNO GEINITZ: Das Königliche mineralogische Museum in Dresden. 110 pp. 12mo.—A catalogue of the minerals of the Dresden Museum and a plan of the building and arrangements.

C. U. SHEPARD: Report of the Mount Pisgah Copper Mine. 8 pp. 8vo. New Haven, 1859.—The copper ore is chalcopyrite. It occurs in gneissoid mica schist. The other minerals of Mt. Pisgah are vivianite in fine crystals, automolite, apatite, hyalite, staurotide, tremolite, chrysocolla, etc. An impure chlorite from the region is named *lepidochlore*. There is no analysis given, and no other good foundation for the new name.

In the same pamphlet, Prof. Shepard proposes names for mineral substances (of which he promises future descriptions) from Ducktown, a copper mine in the same vicinity, in eastern Tennessee. These names are *Copperasine* for a "hydrated ferrous cuprous and ferric sulphate;" *Leucanterite* for an efflorescence on the copperasine; *Rusibite* for a "rusty insoluble ferric sulphate;" *Stephensonite* for a "hydrosulphato-carbonate of copper, of a chrysoprase green color." Until they are fully described by the author, and complete analyses given, with other evidence that they are good species, these names can have no claims to recognition in the science. A common blackish copper ore from Ducktown is named *ducktownite*, making five so-called species from Ducktown. The mineral appears to the eye to be only a mixture. H.=5·5. G.=4·55—4·66 (Mr. R. A. Fisher). Color blackish steel-gray with a shade of bronze. Said to contain 30·76 iron, 26·04 copper, with 43·20 undetermined, but set down as "sulphur, by difference."

Prof. G. J. Brush has handed me the following notices of the Ducktownite and Lepidochlore.

"Having recently visited the Ducktown mines, I have obtained specimens of the so-called new species *ducktownite*, and after assuring myself of their authenticity by comparison with a specimen received from Prof. Shepard, I have submitted them to examination. A careful inspection with the magnifier shows that besides the quartz, malachite and limonite mentioned by Prof. Shepard, that the mass is made up of an intimate mixture of two substances, one of which has a bronze and the other a steel or blackish-gray color. Occasionally the mixture contains a small quantity of yellow copper pyrites. The bronze colored mineral selected as carefully as possible gave the following characters. Before the blowpipe in matrass yielded a copious sublimate of sulphur, indicating one of the higher sulphids. Pulverized and roasted in an open tube gave a reaction for sulphur and left a reddish residue. Fused on charcoal the assay became magnetic. A specimen carefully roasted on charcoal till sulphur ceased to be given off, was dissolved in salt of phosphorus; it gave a reaction for iron only, no reaction for copper was obtained even on fusing the bead with chlorid of sodium, thus proving the mineral to be entirely free from copper. Its hardness was sufficient to scratch feldspar; this together with the reactions in the matrass and on charcoal indicate that the substance under examination was *iron pyrites*.

The blackish-gray substance gave off no sulphur when examined in the matrass, but yielded sulphurous acid when treated in the open tube and on charcoal, and showed the presence of a large amount of copper. In hardness it was very inferior to the bronze mineral, but its mixture with the latter prevented an accurate determination. An assay made of a fragment of this mixture, containing a small amount (not over one or two per cent at most) of malachite and perhaps also a

small quantity of limonite, gave 46·70 per cent of metallic copper. The mixture with iron pyrites and the associating minerals was such that it was almost impossible to select the blackish-gray mineral pure.

These facts, however, are sufficient to prove that *ducktownite* is not a homogeneous substance. The low amount of copper obtained by Prof. Shepard is explained by his specimen having contained a very considerable admixture of iron pyrites. The substance I have examined is a mixture of iron-pyrites and a rich sulphid of copper, which if obtained pure would probably prove to be copper-glance. I am requested by Dr. R. A. Fisher to state that the specific gravities quoted by Prof. Shepard were taken upon fragments which contained malachite, quartz, and limonite, and are of no value further than as an approximative density of the ore.

In Professor Shepard's description of the substance he calls *lepidochlore*, he quotes me as authority for its specific gravity and chemical composition. The only examination I have made of it was to determine the density and the amount of water it contained, and in my report to Prof. Shepard I gave these with the remark, '*appears to be a mixture of chlorite and mica*.' Prof. Shepard gives no physical or chemical characters which distinguish the mineral from chlorite."

CH. HERPIN: Sur la Nomenclature et la Classification des eaux Minérales. 8vo. Paris, 1859.

J. HOUËL: Des principales eaux minerales de l'Europe. 8vo. Paris, 1858.

On the Microscopical Structure of Crystals, by H. C. Sorby, Quart. Journ. Geol. Soc., xiv, 453.—Treats mainly of the cavities in crystals, and draws from them some conclusions with regard to the origin of the rocks in which the crystals occur.

A list of pseudomorphic minerals occurring in Scotland, by Dr. Heddle (Phil. Mag., [4], xvii, 42.

On Pseudomorphism, or the Perimorphosis of Calcite and Epidote into Garnet, by A. Knop of Giessen, Jahrb. Min., 1858, 33.

On Heteromerism and Heteromerous minerals, by R. Hermann, J. f. pr. Chem., lxxiv, 256—314, lxxv, 385—448.

Alteration of Minerals.—Dr. H. Eichhorn has published (Pogg., cv, 126) an important paper on this subject. Pulverized *chabazite* was exposed to different weak solutions. (1) 4·0 grams of chabazite in water containing 4·0 grams of common salt to 400 cubic centimetres, for 10 days in the cold; (2) 15·0 grams, with 10·0 grams of chlorid of ammonium and 500 c. c. of water for 21 days; (3) 15·0 grams, with 20 grams crystallized carbonate of soda and 500 c. c. of water, for 21 days; (4) 15·0 grams with 10·0 grams of carbonate of ammonia in 500 c. c. water for 21 days. The following are analyses of true chabazite and the altered products:

			$\dddot{\overline{\mathrm{Si}}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{H}}$
	Chabazite,		47·44	20·69	10·37	0·65	0·42	20·18= 99·75
Altered	"	1,	48·31	21·04	6·65	0·64	5·40	18·33=100·37
"	"	2,	51·26	22·17	4·15	[0·61]		14·87 AmO 6·94=100
"	"	3,	48·39	20·76	5·64	6·86		18·46=100·11
"	"	4,	50·61	21·26	5·63	[0·87]		15·72 AmO 5·91=100.

Descriptions of Species.

ACICULITE.—This ore from Beresowsk, has afforded R. Hermann (J. f. pr. Ch. lxxv, 450):

S 16·50 Bi 34·87 Pb 36·31 Cu 10·97 Ni 0·36 Au 0·09 = 99·00

corresponding to the formula $(\mathrm{Cu}, \mathrm{Pb})\mathrm{S} + 3\mathrm{Bi}\,\mathrm{S}^3$.

ADELPHOLITE, *A. E. Nordenskiold* (Beskrif. Finland Min., &c., Jahrb. Min. 1858, 313).—A niobate or tantalate of iron and manganese with 9·7 per cent of water. Crystallization dimetric, the angles undetermined. H.=3·5—4·5. G.=3·8. Lustre greasy, subtranslucent. Brownish yellow to brown and black. Streak white or yellowish white. From Rajamaki in Tamela, Finland, with beryl and small crystals of tantalite.

AGALMATOLITE [p. 252, V].—Scheerer has referred the minerals from China included under Agalmatolite to three groups (Handwört. Chem.).

1. Common agalmatolite *or hydrous potash-alumina silicate.—First division* containing 1K̇, 3Al̈, 6S̈i, 3Ḣ, [Min., p. 253, anal. 1, 2]. A *second* kind is mentioned under this group having the same constituents except 3Ṙ in place of 1K̇. It is based on Thomson's analysis. [Min., anal. 3.]

2. *A hydrous alumina-silicate.*—He here includes Klaproth's analysis (Beit., ii, 89), S̈i 62, Al̈ 24, Ċa 1, ḞeÖ 0·05, Ḣ 10—97·50; also Lychnell and Walmstedt's Min., p. 253].

3. *A hydrous magnesia-silicate,* or *steatite.*

Under the first group he places, besides Chinese specimens in a *first* division, the agalmatolite of Nagyag analyzed by Klaproth [Min., anal. 2]; a *second* that of Ochsenkopf, analyzed by John, and near Onkosin; a *third* the agalmatolite of Schemnitz, analyzed by Karafiat [Min., anal. 4], and the parophite and dysyntribite. These three divisions differ in having for the protoxyds, the first 1Ṙ, the second 2 Ṙ, the third 3Ṙ.

[Scheerer, in his valuable paper, fails to note that *parophite* was described as a rock and not as a mineral by T. S. Hunt; and that *dysyntribite* was also proved to be a rock by Smith and Brush. The relation to agalmatolite is undoubted. But owing to the impurities present, it is not safe to infer the precise composition from the analyses. G. J. Brush in his article on the Gieseckite of Northern New York (this Jour., xxvi, 64, July, 1858, and VI Suppl., p. 350), shows that this gieseckite is in fact a potash-agalmatolite, and as it comes from the same region with the dysyntribite it is obvious that the latter is the same compound in an impure state. The constituents found by him were 6Ṙ, 7R̈, 12S̈i, 9Ḣ=(Ṙ³, R̈, Ḣ³)S̈i, which brings it most nearly to the third division. Prof. Brush also shows that the potash-pinites and liebenerite are related to the gieseckite and potash-agalmatolite. Besides, in his remarks on pyrophyllite (same vol. this Jour., p. 68), he proves that the "hydrous alumina silicate" agalmatolite, or that of the second group, is compact pyrophyllite, as suggested by Walmstedt.—D.]

ALISONITE, *Field* (this Jour., [2], xxvii, 387).—Alisonite is a sulphuret of lead and copper, from "Mina Grande," near Coquimbo, Chili. It has a deep indigo-blue color, quickly tarnishing on exposure; G.=6·10; H.=2·5—3. Associated with cerusite and malachite, and also vanadate of lead and copper. Composition:

S 17·00 Cu 53·63 Pb 28·25 = 98·88

corresponding to 3ЄuS, PbS, which requires Cu 53·33, Pb 28·88, S 17·77.

ANALCIME [p. 318, IV].—Rammelsberg has published some analyses of analcime in Pogg., cv, 317, sustaining the received formula. He mentions reasons for doubting the analysis of von Waltershausen [Min., No. 8].

APATITE [p. 396, I—VI].—An apatite from Krageroe, Norway, according to Völcker (Rep. Brit. Assoc., Dublin, 1857) contains no fluorine.

ARAGONITE [p. 448, II, III, IV, V].—The variety of aragonite containing lead, called *tarnowitzite*, has been examined crystallographically by Websky (Zeits. D. geol. Ges., ix, 737). The crystals were from Lazarowka, one to three lines long, and one-fifth to one line through. The faces observed are I, i-ĭ, ½-ĭ, 1-ĭ, 1, ½, 2-2̆, $\frac{4}{3}$-2̆, 2̆, $\frac{1}{3}$-2̆, $\frac{4}{3}$-2̆, $\frac{2}{3}$-2̆, $\frac{4}{3}$-$\frac{3}{2}$̆, $\frac{27}{2}$-$\frac{27}{25}$̆. The angles by measurement, $I:I$=116° 13′, I:1=143° 36′. By calculation, 1-ĭ : 1-ĭ=108° 34′. Three very complex twins are finely figured on the plate.

A fine green aragonite occurs near Gerfalco in Tuscany, in radiated columnar forms. Marcel de Sevres attributes the color to the oxyds of copper and iron.—*L'Institut*, 1858, p. 351.

ASBOLAN OR EARTHY COBALT [p. 126].—On the occurrence of Cobalt, and nickel ores in Gaston Co., North Carolina, H. Wurtz (Am. J. Sci., [2], xxvii, 24).

AUTUNITE [p. 430, IV (p. 130), V, VII].—According to Descloizeaux, autunite is optically biaxial, and the prism, instead of square, is rhombic, with $I:I$=90° 43′.—*L'Institut*, 1859, 38.

BARNHARDITE [p. 500, I].—Under the name of *Homichlin*, Breithaupt has described an ore from Plauen in Voigtland (B. u. H. Zeit., xvii, 385, 424, and xviii, 65), identical with barnhardite in composition and other characters. Crystallization dimetric octahedral; mostly compact massive; G.=4·472—4·480; H.=4—5. Color a little more bronzy than chalcopyrite; streak black. *Composition* according to an imperfect analysis by T. Richter, Iron 22·1, copper 43·2. leaving 34.7 for sulphur and a small admixture of earthy substances. Richter writes the formula $2\dot{C}uS+FeS^3$=Iron 22·3, copper 48·2, sulphur 30·5, which is precisely the composition given by Genth for the barnhardite. It is associated with kupferpecherz and malachite. Other localities are, Friedensgrube near Lichtenberg in Bavaria, Duchy of Hesse near Viedendorf, and at Breitenstein near Viedenkopf, Duchy of Nassau at Oberlahnstein, Kupferberg in Silesia, Johanngeorgenstadt, Lauterbach in the Hartz, Rheinbreitenbach on the Rhine, Quadmerget in Algeria, Chili at Remolinos and Tocopilla and Japan.

BARYTES [p. 366, II, V, VI].—The brachydome $\frac{1}{8}$-$\bar{i}$ has been observed by E. J. Chapman in a barytes crystal in the Museum of the University of Toronto (Canadian Jour. iv, 55).

BINNITE [II, III, IV].—This monometric mineral from Binnen valley contains, according to Stockar-Escher, (Kenngott's Min. Forsch. for 1856, '57, p. 174):

S	As	Cu	Ag
32·73	18·98	46·24	1·91

according to which the ratio for the As, S, Cu is 1 : 8 : 8, and he observes it is identical with *enargite* except in crystallization.

BLENDE [p. 45, II, V].—A brown blende from near Burbach in the Siegen district afforded C. Schnabel (Pogg., cv, 144) ZnS 70·45, FeS 12·59, insol. resid. 16·96 =5ZnS+FeS.

BOLTONITE [p. 167, I].—G. J. Brush has analyzed anew the boltonite of Shepard, and confirmed Dr. Smith's result that the mineral is *chrysolite*. He has also shown that the analysis of von Hauer, and the arguments of Kenngott based upon it, are wrong. He obtained (this Jour., xxvii, 395)—

$\ddot{S}i$	$\dot{M}g$	$\dot{F}e$	$\dot{C}a$	$\ddot{\bar{A}}l$	ign.
42·82	54·44	1·47	0·85	*tr.*	0·76=100·34

It is therefore a very pure *magnesia-chrysolite*, a variety of the species not yet found elsewhere. H.=6—6·5. G.=3·21. Color ash-grey, but fragments almost colorless and nearly transparent. Cleavage very distinct in one direction. The crystals are imbedded in a limestone gangue, and the sections of them are often rectangular.

BORNITE.—See *Tetradymite*.

BREWSTOLINE [p. 471].—R. T. Simmlen has published a paper (Pogg., cv, 460), aiming to show that the expansible fluid observed by Brewster in topaz, quartz and amethyst, is *liquid carbonic acid*. The expansion of the Brewstoline in a change of temperature from 50° to 80° F. was 25 per cent; and according to Thilorier, liquid carbonic acid expands between 32° and 86° F. 45 per cent. In the former the rate per degree is 0·832, in the latter 0·833. The index of refraction of the Brewstoline, according to Brewster, is 1·1106 for a specimen in a Siberian amethyst, and 1 1311 for one in a Brazilian topaz, or less than the number for water (1·336); and although the exact number for carbonic acid has not been observed, it is stated by Davy and Faraday to be less than that of water.

BROCHANTITE [p. 391].—Brochantite, according to F. Sandberger (Pogg., cv, 614), occurs in Nassau, along with chalcopyrite, galena and chalybite, malachite and allophane. An analysis by H. Risse afforded $\dddot{S}$ 19·0, $\dot{C}u$ 67·8, $\dot{H}$ 13·2, and *trace* of chlorine, corresponding to the formula $\dot{C}u^7\dddot{S}^3+6\dot{H}$.

CALAMINE [p. 313, II].—Analysis of the white or colorless calamine from Santander in Spain, by C. Schnabel (Pogg., cv, 144):

$\ddot{S}i$	$\dot{Z}n$	$\ddot{\bar{A}}l, \ddot{\bar{F}}e$	$\dddot{\bar{P}}$	$\dot{H}$	
23·74	66·25	1·08	*tr.*	8·34=99·41.	G.=3·42.

CALCIFERRITE, *J. R. Blum* (Jahrb. Min., 1858, 287).—A mineral related to vivianite, of a sulphur-yellow, greenish yellow to siskin-green and yellowish white color, and sulphur-yellow streak; occurs crystalline foliated, with one very perfect cleavage affording thin lamellæ, and traces in two other directions, one at right angles to the perfect cleavage face and the other oblique. H.=2·5; G.=2·523—2·529, Reissig. Thin lamellæ translucent. B.B. affords a black shining magnetic globule. Easily decomposed by muriatic acid. Analysis by M. Reissig afforded—

	$\dddot{P}$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{H}$
	34·01	2·90	24·34	14·81	2·65	20·56=99·27
Oxygen,	19·16	1·35	7·27	4·23	1·06	18·27

affording therefore as the oxygen ratio for the protoxyds, sesquioxyds, phosphoric acid and water, nearly 6 : 9 : 20 : 20=6Ṙ, 3$\ddot{R}$, 4$\dddot{P}$, 20Ḣ. Occurs in nodules in a deposit of clay at Battenberg in Rhenish Bavaria. The exterior of the nodules is massive and yellowish brown or reddish brown, and consists of the impure or altered calciferrite.

CALCITE [p. 435, I—VI].—A grass green cleavable calcite from Central India contains according to S. Haughton (Phil. Mag., [4], xvii, 16), a siliceous skeleton, amounting to about 14 per cent of the whole, to which it owes its green color. The skeleton afforded on analysis—

$\dddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{H}$ and loss
54·59	4·74	22·84	0·94	4·90	11·99=100

giving the formula $(\dot{R}^3, \ddot{R})\dddot{S}i^3 + 3\dot{H}$. Mr. Haughton observes that the composition resembles that of *glauconite*. He names the rock, which is merely a mixture of calcite and the green mineral, Hislopite.

Analyses of many limestones by J. W. Mallet are given in Tuomey's Second Biennial Report on the Geology of Alabama; others by J. D. Whitney in Hall and Whitney's Report on Iowa.

CALDERITE.—See *Garnet.*

CASSITERITE.—The tin ore of the veins at Evingtok near Arksut, Greenland, where the cryolite occurs, is associated with ores of lead, copper, zinc, iron and molybdenum, fluor spar, zircon, cryolite, etc. The veins vary from 10 inches to ½ inch in width, and in the largest the tin ore occupies about 1 inch on one side of the vein.

CASTELNAUDITE [p. 432].—See *Xenotime.*

CIMOLITE [p. 165].—A whitish material, a little greasy in lustre, having G.=2·319, found with orthoclase in granite from Nagpur, India, has been analyzed by S. Haughton (Phil. Mag., [4], xvii, 18) and found to contain:

$\dddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{H}$ (ign.)
65·93	20·97	0·30	0·45	11·61=99·26

The oxygen ratio for the alumina (including protoxyds) and silica is about 1 : 3·36. It is stated to be gritty under the agate pestle. Mr. Haughton proposes for the species the name *Hunterite.*

[The species appears to be cimolite, as the characters and composition are essentially the same. The grittiness under the agate pestle appears to indicate a slight admixture of free silica.—D.]

COBALT, Black.—See *Asbolan.*

CONARITE, *Breithaupt*, B. u. H. Zeit., xviii, 1.—Supposed to be a hydrous phosphate of nickel. It occurs at Röttis in Voigtland with Breithaupt's Röttisite (which see). It is in small grains and crystals, with one perfect cleavage, and is probably monoclinic like vivianite, with the cleavage brachydiagonal. H.=2·5—3. G.=2·459—2·490. Color yellowish pistachio- and siskin-green, also olive-green; streak siskin-green. In thin lamellæ translucent. It is named from the Greek κωναρος, *evergreen.*

Copperasine.—See page 129.

CROCOISITE [p. 359].—Dauber has measured the angles of crocoisite with great care and published the results in Pogg. Ann., cvi, 150. He makes $I:I=36° 31'4$, $i2:i2=50° 24'$, $C=77° 22' 43''$, with a possible error of $1' 52''$, and the axial ratio for the orthodiagonal, clinodiagonal and vertical axis, is 1 : 0·96388 : 0·91751.

DEWEYLITE [p. 285].—Kenngott in his last supplement (p. 67, published in 1859) continues to place Deweylite under *Gymnite*, although the former name has the priority.

DIALLOGITE [p. 446, III].—Massive diallogite has been found at Placentia Bay, Newfoundland (T. S. Hunt in Logan's Canada Rep. for 1857), in slates supposed to be of Silurian age. Color fawn- to chestnut-brown. H.=4. G.=3·25. It contains, according to T. S. Hunt, 84·6 p. c. of carbonate of manganese, with 14·4 per cent of silica, with small portions of iron, lime and magnesia. All but two per cent of the silica were readily soluble in a dilute solution of potash.

DOLOMITES [p. 441, I, II, IV].—Analyses of many dolomites of Alabama by J. W. Mallet are given in Tuomey's Second Biennial Geol. Report of Alabama; also of dolomites of Canada, by T. S. Hunt, in Logan's Geol. Rep. Canada for 1857; and in Iowa by J. D. Whitney in Hall and Whitney's Iowa Report.

Dolomitic veins or spots in fossiliferous limestone.—According to the investigations of T. S. Hunt (Logan's Canada Rep. for 1857, p. 200), the grayish fossiliferous limestone of Dudswell is ordinary limestone consisting of carbonate of magnesia 1·3, sand 6·2, and the rest carbonate of lime. The fossils have a similar composition. But a yellowish material envelops the fossils or fills the veins, which is dolomitic, consisting of—

$\dot{C}a\ddot{C}$	$\dot{M}g\ddot{C}$	$\dot{F}e\ddot{C}$	Insoluble, sand
56·60	11·76	3·23	26·72 = 98·31

There is here a mixture of dolomite and carbonate of lime; by means of acetic acid the latter was removed (with but 4·0 p. c. of carbonate of magnesia) and the residue (52 per cent) then gave

$\dot{C}a\ddot{C}$	$\dot{M}g\ddot{C}$	$\dot{F}e\ddot{C}$
51·75	35·73	12·52 = 100

The *Portor* marble, a well-known black marble with yellowish veins, brought from the Gulf of Spezzia (and according to Savi of the Neocomian formation), also analyzed by Mr. Hunt, afforded the same results. The body of the rock contained only 1·0 per cent of carbonate of magnesia, while the veins afforded 35·5 per cent.

Ducktownite.—See page 129.

DUFRENOYSITE [p. 77, I, II. III, IV, V].—This prismatic mineral from Binnen valley, contains, according to Stockar-Escher, (Kenngott's Min. Forsch. for 1856, '57, p. 177):

S	As	Pb	Ag	Fe
23·97	22·01	53·30	0·24	—— = 99·52
24·22	25·27	49·22	0·94	0·25 = 99·90
25·30	26·33	46·83	1·62	—— = 100·08
25·77	26·82	47·39	*trace*	—— = 99·98

The mean result gives the formula $3PbS+2As^2S^3$. The last two analyses also approach the formula $4PbS+3As^2S^3$, which differs from that of plagionite or jamesonite, in the substitution of arsenic for antimony.

ELLAGITE, *A. E. Nordenskiöld* (Beskrifv. Finl. Min. etc., and Jahrb. Min., 1858, 313).—Probably monoclinic; two cleavages making 90° with one another. Lustre of cleavage surface pearly, shining; opake or feeble translucent. Color yellow, yellowish brown to yellowish red. Streak uncolored. B.B. yields water and with greater heat an enamel-white pearl. From Aoland in Finland. Formula deduced $\dot{C}a^3\ddot{S}i^4+\ddot{\bar{A}}l\,\ddot{S}i+12\dot{H}$.

ENARGITE.—*F. Field* has described (this Jour., xxvii, 52) under the name of *Guayacanite*, an arsenical sulphuret of copper which he has identified with enargite. It contains, according to Field, S 31·32, As 19·14, Cu 48·50=99·46, with traces of iron and silver. The formula deduced is $3\mathrm{Cu}S+AsS^5$. H.=3·5—4. G.=4·39.

OTE [p. 306, II—VI].—Scheerer has published (J. f. pr. Chem., lxxv, 167) a opposing the analytical results of Hermann with regard to the presence of c acid in epidote. In the epidote of Bourg d'Oisans and Arendal, Scheerer neither carbonic acid nor protoxyd of iron. He states that the same error to Hermann's analyses of idocrase.

ibite.—See p. 129.

KLINITE [p. 166, I].—Franklinite in crystals occurs at the mine Victoria near in Nassau, according to C. Koch. The crystals are cubic. This species was nounced as existing in Nassau at the mine Breitehek by Jung in 1834.—tt's Min. Forsch. for 1856, '57, p. 145.

NA [p. 39, II, III, IV].—A galena affording before the blowpipe, like cuprote, some copper and a trace of antimony, occurs at the mine of Antonio Cruz mayagua in Honduras, according to W. J. Taylor (Proc. Acad. N. Sci. Philad. 858).

ET [p. 190, I—VI].—A mineral from Nepal named *Calderite* is, according iting, massive garnet.—Kenngott's Min. Forsch. for 1856, '57, p. 115.

ysis by R. Richter of a dark-red garnet from Mt. Agiolla in Traversella, nt (Scheerer, in Kön. Sächs. Ges. der Wiss., 1858, p. 99):

$\dddot{Si}$	$\overline{\dddot{A}l}$	$\overline{\dddot{F}e}$	$\dot{C}a$	$\dot{M}g$
39·99	17·98	6·45	32·70	2·76=99·88

n ratio for R, $\overline{R}$, Si=10·44 : 10·83 : 20·76.

our on the Subdivision of the Garnets into four groups.—L'Institut, xxiv, 441, hrb. Min., 1858, 77.

JCONITE.—See under *Calcite*, and this Supplement.

SDORFFITE [p. 58].—Gersdorffite is found in fine crystals near Ems. Compo-ccording to C. Bergemann (J. f. pr. Chem., lxxv, 244):

As	Sb	S	Ni	Co	Fe
45·02	0·61	19·04	34·18	0·27	1·02=100·14

esponds to the formula NiS^2+NiAs.

D [p. 7, I, II, V, VI].—Native gold occurs in Australia imbedded in apatite.

IGYLITE *Thoreld.* A. E. Nordenskiöld (Beskrif. Finl. Min. etc., Jahrb. Min., 813).—An altered mineral occurring massive with cleavage in two directions. 7. H.=4—5. Lustre greasy, subtranslucent. Yellow or yellowish brown. white. B.B. yields water and with a stronger heat fusing to a blebby glass. la, according to Thoreld, $(\dot{M}g, \dot{K})^3 \dddot{Si}^2+3\overline{\dddot{A}l}\dddot{Si}^2+4\frac{1}{2}\dot{H}$, if a part of the iron n as protoxyd. From Yli Kitkajärvi in Finland.

YACANITE.—See *Enargite.*

UNITE.—See *Deweylite.*

IATITE [p. 113, II, III, IV].—Rammelsberg (Pogg., civ, 541) has found the e (octahedral ore) of Brazil to contain 1·83 to 2·30 per cent of ptotoxyd of nd is inclined to regard it as a pseudomorph. Sp. gr. 5·155.

octahedral iron of Vesuvius (ib., p. 542) contains according to Rammelsberg, mostly $\overline{\dddot{F}e}$, either some protoxyd of iron or magnesia. Rammelsberg ob- (1.) $\overline{\dddot{F}e}$ 85·90, $\dot{M}g$ 12·43, insoluble 1·22; (2.) $\overline{\dddot{F}e}$ 82·52, $\dot{M}g$ 15·68, insol. (3.) $\overline{\dddot{F}e}$ 92·91, $\dot{F}e$ 6·17, $\dot{M}g$ 0·82. The crystals are magnetic, and consist of ite in laminæ through a magnesian magnetite. Specific gravity of 1 and 2, and 4·659, which is less than in either hematite or magnetite; of 3, 5·285.

SCHELITE [under Gmelinite, 321].—Descloizeaux has found that *herschelite* negative axis of refraction, and *hydrolite*, which is considered a variety of elite, a positive axis.—L'Institut, 1859, 83.

MICHLIN *Breithaupt.*—See *Barnhardite.*

NBLENDE [p. 170, I, II, III, IV, VI].—Scheerer has reviewed at some length aper on the composition of the Hornblende and Pyroxene group of minerals, g., cv, 598.

HYALOPHANE [I, III, V].—Stockar-Escher has analyzed hyalophane and found it to contain (Kenngott's Min. Forsch., 1856, '7, p. 107):

$\dddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{Ba}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Na}}$	ign.
52·67	21·07	15·05	0·46	0·04	7·82	2·14	0·58=99·83

This makes it an oligoclase with part of the protoxyds replaced by baryta, giving the formula $(\dot{\mathrm{K}}, \dot{\mathrm{Ba}})\dddot{\mathrm{Si}} + \dddot{\bar{\mathrm{A}}}\mathrm{l}\dddot{\mathrm{Si}}^{2}$. Specific gravity =2·801.—Kenngott's Min. Forsch. for 1856, '57, p. 107.

ILMENITE [p. 115, II, V].—The varieties of titanic iron have been investigated recently by Rammelsberg (Pogg., civ, 497). The following are the mean results of his analyses. The last column contains the ratio of $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$ to $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ which he has deduced from the composition. 1, from Ingelsberg near Hof-Gastein, [same analysed by von Kobell, Min. No. 1]; 2, Layton's Farm, near Warwick, Orange Co., New York; 3, Ilmen Mts., Ural [Min., Nos. 3, 4, 5, and Schmidt below]; 4, Egersund, Norway [Min., Nos. 7, 8, 9, 10]; 5, Krageröe, Norway; 6, *Iserine*, from Iserwiese; 7, *Washingtonite*, Litchfield, Ct. [Min., Nos. 13, 14]; 8, Eisenach; 9, Snarum, Norway; 10, Binnen Valley; 11, *Eisenrose*, St. Gothard [Min., No. 17]; 12, Krageröe. —The analyses A, B, C, are of anomalous titanic irons; A, Iserine, in grains which may be octahedral, or rhombohedral with the apex truncated; B, from the basalt of Unkel [Min., under Iserine]; C, titaniferous iron sand, magnetic, from the shores of Muggle Lake near Berlin.

	Sp. gr.	$\ddot{\mathrm{Ti}}$	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$		Ratio. $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$: $\dddot{\bar{\mathrm{F}}}\mathrm{e}$
1.	4·689	53·08	2·66	38·30	4·30	1·65	= 99·94	1 : 0
2.	4·313 & 4·293	57·71	——	26·82	0·90	13·71	= 99·14	1 : 0
3.	4·81—4·873	45·93	14·30	36·52	2·72	0·59	=100·06	6 : 1
4.	4·744 & 4·791	51·30	8·87[a]	39·83	*trace*	0·40	=100·40	9 : 1
5.	4·701	46·92	11·48	39·82	——	1·22	= 99·50	9 : 1
6A.	4·752	37·13	28·40	29·20	3·01	2·97	=100·71	3 : 1
6B.	4·676	42·20	23·36	30·57	1·74	1·57	= 99·44	3 : 1
7.	4·986	23·72	53·71	22·39	0·25	0·50	=100·57	1 : 1
8.	5·060	16·20	69·91	12·60	0·77	0·55	=100·03	1 : 2
9.	4·943	10·02	77·17	8·52	——	1·38	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 1·46=98·50	1 : 4
10.[b]	5·127 & 5·150	9·18	81·92	8·60	——	——	= 99·70	1 : 4
11.	5·187 & 5·209	9·10	83·41	7·63	0·44	*tr.*	=100·58	1 : 4
12.	5·2406	3·55	93·63	2·26	——	——	=100·44	1 : 13
A.	4·400	57·19	15·67	26·00	——	1·74	=100·60	
B.	4·905	8·27	51·81	37·22	2·03	0·78	=100·11	
C.	5·075	5·20	61·36	30·25	1·23	0·48	= 98·52	

[a] Trace of $\dot{\mathrm{M}}\mathrm{n}$. [b] Mean of two analyses.

The more important conclusions of Rammelsberg from his researches are as follows:—(1.) The common composition is $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$. (2.) Magnesia in the most of them replaces part of the protoxyd of iron; and in that from Layton's farm near Warwick, it amounts to 14 per cent, the composition corresponding to the formula $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}} + \dot{\mathrm{M}}\mathrm{g}\ddot{\mathrm{Ti}}$. (3.) The preferable theory for the composition of the species is that of Mosander which makes it a titanate of protoxyd of iron, $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$ (the iron sometimes replaced by magnesium) with often more or less $\dddot{\bar{\mathrm{F}}}\mathrm{e}$, and usually in simple proportions; Rose's theory considers the varieties combinations of isomorphous sesquioxyds of titanium and iron, and this would require the existence of a sesquioxyd of magnesium. Rammelsberg also concludes that there is no true octahedral titanic iron, and that Iserine (analysis A) is a combination of $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$ and $\dddot{\bar{\mathrm{F}}}\mathrm{e}\ddot{\mathrm{Ti}}^{3}$ in the ratio of 4 : 1.

[The ratios between the $\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{Ti}}$ and $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ deduced by Rammelsberg are not in most cases the precise results of the analyses. Thus in No. 4, the ratio obtained for the protoxyds, titanic acid and sesquioxyd, 0·8 : 2·7 : 6 is made 1 : 3 : 6; and so in some other cases. Rejecting the idea of any titanate of iron being present, and taking simple the atomic ratio between the metals and the oxygen, according to Laurent's view of the constitution of such compounds, all the 12 analyses come quite closely under the formula of hematite, $M^{2}O^{3}$ (the species with which titanic iron is isomorphous), M standing for all the iron, titanium, manganese and magnesium that is

resent. The following table shows that, excepting one or two cases, the coincidence is quite remarkable.

	Metals.	Oxygen.	Ratio.		Metals.	Oxygen.	Ratio.
Anal. 1.	21·77	32·11	1 : 1·48	Anal. 7.	20·52	30·80	1 : 1·50
" 2.	22·71	34·64	1 : 1·52	" 8.	20·29	30·62	1 : 1·51
" 3.	20·67	31·55	1 : 1·50	" 9.	20·14	30·29	1 : 1·50
" 4.	20·09	32·11	1 : 1·60	" 10.	20·07	30·14	1 : 1·50
" 5.	20·58	31·48	1 : 1·53	" 11.	20·23	30·44	1 : 1·50
" 6A.	21·17	31·67	1 : 1·50	" 12.	20·13	30·22	1 : 1·50
" 6B.	20·62	31·64	1 : 1·54				

In analysis A, the corresponding numbers are 20·62 : 33·96=1 : 1·65 ; in B, 21·11 : 1·87=1 : 1·32 ; in C, 21·47 : 27·65=1 : 1·29. The last two are nearly the ratios of agnetic iron (1 : 1·33), and, as Rammelsberg suggests, they appear to be titaniferous magnetite. As to A, which holds an excess of oxygen, Rammelsberg queries reasonably whether the collection of iserine grains might not have contained some free titanic acid (grains of the black variety of rutile), but concluded that it was improbable.—J. D. D.]

Crystals of ilmenite an inch and a half in diameter and half an inch thick have been found, according to W. J. Taylor (Proc. Ac. N. Sci. Philad., August, 1858), in boulder on the Schuylkill near Fairmount, Pa.

IOLITE [p. 214].—A pseudomorph after iolite called *peplolite*, from Ramsberg in Sweden, has been examined by C. P. Carlsson (Kong. Vet. Akad. Förh. 1857, 241). H. = 3—3·5. G. = 2·68—2·75. The mean of three analyses, one by Mr. Sieurin, second by Aomark, and third by Carlsson, gives for the composition:

$\dddot{S}i$	$\overline{\overline{A}}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{H}$
45·95	30·51	6·77	*tr.*	0·50	7·99	8·30 = 100·02

whence the oxygen ratio for $\dot{H}$, $\dot{R}$, $\overline{\overline{R}}$, $\dddot{S}i$, 1·52 : 1·00 : 2·95 : 4·93.

IRON (native) [p. 17, II].—Pieces of native iron are reported to have been found at Chotzen in Bohemia, imbedded in a limestone, the *Plänerkalk* (K. A. and J. G. Neumann, in the Jahrb. k. k. Geol. Reichs., 1857, 354). J. G. Neumann suggests that it is of meteoric origin, of the age of the Plänerkalk. An analysis afforded, iron 98·33, graphite 0·74, arsenic 0·32, nickel 0·61. Its structure is not at all crystalline.

IWAARITE.—See *Schorlomite.*

KARELINITE, *R. Hermann* (J. f. pr. Chem., lxxv, 448).—Karelinite is an oxysulphuret of bismuth, according to the analysis by Hermann, which afforded—

Oxygen 5·21 Sulphur 3·53 Bismuth 91·26

whence the atomic ratio for O, S, Bi, 3 : 1 : 4, corresponding to BiO^3+BiS. It is from the Sawodinsk mine in the Altai Mts., where it occurs with telluric silver. Lustre metallic. Fracture crystalline, cleavage perfect in one direction. Color lead-gray. H.=2. G.=6·60. It is mixed with gray earthy bismuthite ($3\dddot{B}i\ddot{C}+\dddot{B}i\dot{H}^4$). B.B. gives fumes of sulphurous acid, and a gray slag with a bead of bismuth. Named after Mr. Karelin who brought it from Siberia.

KAPNICITE [V].—This mineral, according to the examinations of Städeler, is probably wavellite, it containing $\dddot{\dddot{P}}$ 35·49, $\overline{\overline{A}}l$ 39·59, with 24·92 (loss) water.—Kenngott's Ueb. Forsch. for 1856, 1857, p. 33.

KEILHAUITE [341, I, III].—Analysis of the Keilhauite by Rammelsberg (Pogg. Ann., cvi, 296):

	$\dddot{S}i$	$\ddot{T}i$	$\overline{\overline{F}}e$	$\overline{\overline{A}}l$	$\dot{C}a$	$\dot{Y}$	$\dot{M}n$	$\dot{M}g$	$\dot{K}$	ign.
1.	29·48	26·67	6·75	5·45	20·29	8·16	*trace*	0·94	0·60	0·54
2.	28·50	27·04	5·90	6·24	17·15	12·08	*trace*	*trace*	—	3·59

The second was made on a crystal, but it was a little altered and softened at the surface. Rammelsberg obtains for the oxygen of $\dot{R}$, $\overline{\overline{R}}$, $\ddot{T}i$, $\dddot{S}i$, the ratio 7·79 : 4·56 : 10·59 : 15·31 in No. 1, and 7·30 : 4·68 : 10·73 : 14·80 in No. 2. He unites the oxygen

of the silica and titanic acid, and derives thence for $\dot{R}+\bar{R}$, $\ddot{Ti}+\dddot{Si}$, the ratios 1 : 2·01, 1 : 2·13, and writes the formula $5(\dot{C}a, \dot{Y})\dddot{Si}+(\bar{Al}, \bar{Fe})\ddot{Ti}^3$.

[The mean of the two analyses affords in fact very nearly 7·5$\dot{R}$: 1·5$\bar{R}$: 5$\frac{1}{4}\ddot{Ti}$: 5$\dddot{Si}$ (=7·5 $\ddot{Si}$), or 5$\dot{R}$: 1$\bar{R}$: 3·5$\ddot{Ti}$: 5$\dddot{Si}$, which gives one-sixth too much titanic acid for the above formula. Under ilmenite (page 136) it is shown that the composition of that species is best expressed by a formula in which the titanium is not in the state of titanic acid, but in that of a metal replacing the other metals, in accordance with Laurent's theory. The fact confirms the view taken of sphene in the Mineralogy, in which Rose's formula, $2\dot{C}a\dddot{Si}+\dot{C}a\ddot{Ti}^3$ ($=3\dot{C}a+3\ddot{Ti}+2\dddot{Si}$) is made equivalent to $\bar{R}^3\dddot{Si}^2$, (since $\dot{C}a+\ddot{Ti}=RO+RO^2=R^2O^3$, and $3\dot{C}a+3\ddot{Ti}=3R^2O^3=3\bar{R}$). The oxygen ratio between the silica and other ingredients in sphene is 2 : 3. Now in the above analyses by Rammelsberg, there is the same oxygen ratio between the silica and the other ingredients, it being in No. 1, 15·31 to 22·94=2·002 : 3·000, and in No. 2, 14·80 : 22·71=1·96 : 3; 2 : 3 is therefore the *fundamental* ratio of the species (and this is so, of course, whether silica be $\dddot{Si}$ or $\ddot{Si}$). Hence comes the formula $(\dot{R}^3, \bar{R})^3\dddot{Si}^2$, which is equivalent to $(\dot{R}^3, \bar{R})\dddot{Si}^{\frac{2}{3}}$, as given in the Mineralogy, p. 341, from Erdmann's analysis, and since confirmed by Forbes. Erdmann's analyses, as calculated by Rammelsberg, afford the same result, giving for the ratio 15·58 : 23·79 =1·97 : 3; and 15·30 : 23·44=1·96 : 3.—J. D. D.]

KRANTZITE, *C. Bergemann* (J. f. p. Chem., lxxvi 65).—Krantzite is a fossil resin from the brown coal of Lattorf, and had been considered impure amber. It occurs in grains and roundish pieces, showing by its structure that it was once fluid. Color yellowish, but mostly brown to black from earthy impurities. It is so soft as to be easily cut, and is elastic; no peculiar smell; G.=0·968; or of the crust portion 1·002. Fuses at 225° C. without change of color, and is perfectly fluid at 288°; at 300° there distils over a brownish oil of very disagreeable and penetrating odor.

LABRADORITE [237, II].—A. E. Nordenskiöld has given the name *Ersbyite* to the anhydrous scolecite of Nordenskiöld the father [Min., p. 237]. It is monoclinic, or perhaps triclinic, and has the formula $\dot{C}a\dddot{Si}+\bar{Al}\dddot{Si}$, the formula of labradorite. From Ersby.—Beskrifv. Finl. Min. etc., in Jahrb. Min., 1858, 313.

LAPIS LAZULI [229, VI].—Two Siberian localities of lapis lazuli are described by N. Wersseloff in the Bull. de la Soc. Imp. des Naturalistes de Moscou, 1857, No. 4, p. 518. The mineral occurs in limestone intersecting syenite. As remarked by Nordenskiöld, the colorless and greenish lapis lazuli becomes blue on heating.

LAZULITE [404, II].—Lazulite occurs in beautiful sky-blue crystals in Lincoln Co., Georgia, on Graves' Mountain, about twelve miles northwest of the auriferous belt known as the Columbian gold mines, 50 miles above Augusta, as described by C. U. Shepard (this Jour., [2], xxvii, 36). In the same region occur kyanite, rutile, pyrophyllite, hematite. The lazulite occurs in certain layers of a bed of itacolumite disseminated through them in crystals from one-quarter to one inch long. The paper contains figures of the forms.

LEADHILLITE [371].—According to C. U. Shepard (this Jour., xxvii. 40) occurs in small quantities at the Morgan Silver Mine, in Spartanburg District, S. C., with pyromorphite and cerusite.

LEPIDOMELANE [227].—The black mica, &c., see Geol. Soc. Proc. in Phil. Mag., xvi, p. 396.

LIMONITE [131, II, IV].—Analyses of various limonites of Alabama are given in Tuomey's Second Biennial Geol. Rep. of Alabama.

LIROCONITE [429].—The crystallization of liroconite, according to Descloizeaux (L'Institut, 1859, 33) is monoclinic, having $I : I$=74° 21′, and the vertical axis inclined 25° from a vertical.

MAGNETITE [105, II, IV, VI].—Rammelsberg in Pogg., civ, 536, gives several analyses. In some there is a little magnesia. One from basalt near Eisenach,

afforded 0·10 titanic acid and 1·20 magnesia, with $\ddot{F}e$ 69·88, $\dot{F}e$ 27·88=99·06. See further under ilmenite and hematite.

MELLITE [475, II].—A new locality has been found in Russia, in the district of Nertschinsk, at the mine of Dmitrirwsk, in bituminous coal.

MICROCLINE [242, VI].—Breithaupt has described (Berg. u. Hütt. Zeit., xvii, 324) a twin consisting of albite and microcline, in which the two have the vertical axis parallel and the faces of perfect cleavage (*P*) precisely coincident, showing an identity in the inclinations of the planes. Breithaupt cites an analysis from Pogg., lii, 467, by Awdajeff, agreeing with microcline in the composition, affording, viz., $\ddot{S}i$ 67·20, $\ddot{A}l$ 20·08, $\ddot{F}e$ 0·18, $\dot{K}$ 8·85, $\dot{C}a$ 0·21, $\dot{M}g$ 0·31, $\dot{N}a$ 5·06, the formula of which may be written $[\dot{K}\ddot{S}i+\ddot{A}l\ddot{S}i^3]+[\dot{N}a\ddot{S}i+\ddot{A}l\ddot{S}i^3]$.

MOLYBDENITE [66, I, IV].—Observations on the crystallization of molybdenite are published by A. Knop, in Jahrb. Min., 1858, 43.

NATROLITE [327, VI].—R. Blum has a paper on the pseudomorphs of natrolite after oligoclase and nepheline, from the zircon-syenite of Norway, in Pogg., cv, 133, showing that the natrolite is not an original mineral of the rock, as Scheerer argued, but a result of alteration.

NEOTOKITE [169].—This mineral, according to A. E. Nordenskiöld (Beskrif. Finl. Min., Jahrb. Min., 1858, 313, and Kopp's Jahresb. for 1857), has the formula $\dot{M}g\ddot{S}i+4(\dot{F}e, \dot{M}n)\ddot{S}i+8\dot{H}$. It is amorphous. G.=2·7—2·8. H.=3·5—4·0. Color black to brownish-black. Streak brown. Opaque or feeble subtranslucent. B.B. yields water, but is infusible. From Gaosböle in Finland.

NICKEL ORES.—C. Bergemann has described (J. f. pr. Chem., lxxv, 239) two new arsenates of nickel, differing from the common arsenate in containing no water and also pure oxyd of nickel. They occur at Johann-georgenstadt.

(1.) Crystalline, sometimes amorphous. Dark grass green. H.=4. G.=4·838. No fumes on heating in a glass tube. B.B. on charcoal, arsenical fumes.

(2.) Amorphous. Sulphur-yellow. H.=4. G.=4·982. With heat like the preceding. Composition:

	$\ddot{A}s$	$\ddot{P}$	$\dot{N}i$	$\dot{C}o$	$\dot{C}u$	$\ddot{B}i$	$\ddot{F}e$	
(1.)	36·57	0·14	62·07	0·54	0·34	0·24	*tr.*	= 99·90
(2.)	50·53	*tr.*	48·24	0·21	0·57	0·62	—	=100·17

Formula of (1.) $\dot{N}i^5\ddot{A}s$=arsenic acid 38·01, oxyd of nickel 61·99.

Formula of (2.) $\dot{N}i^3\ddot{A}s$=arsenic acid 50·54, oxyd of nickel 49·46.

(3.) The *oxyd of nickel* occurs in regular octahedral crystals with faces of the rhombohedron, one-half a line long. Color dull pistachio-green. H.=5—6. G= 6·398. Composition, pure protoxyd of nickel. The crystals are not perceptibly attacked by acids or by fusion with alkaline carbonates.

NICKEL-GYMNITE [286].—Reported by W. J. Taylor (Proc. Ac. N. Sci. Philad., Aug. 1858) from Webster, Jackson Co., N. C., where it occurs as an amorphous reniform incrustation in serpentine along with chromic iron. Color apple-green to a yellowish-green. H.=3.

Breithaupt has described under the name of *Röttisite* (B. u. H. Zeit., xviii, 1) an impure hydrous silicate of nickel from Röttis in Voigtland. It occurs in amorphous masses and incrustations or seams, of a nearly pure emerald-green to apple-green color, apple-green streak, little lustre, translucent to subtranslucent, and opaque when earthy; H.=2—2·5; G.=2·358—2·370. An analysis by C. Winkler is given as follows:

$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{N}i$	$\dot{C}o$	$\dot{C}u$	$\dot{H}$	$\ddot{P}$	$\ddot{A}s$
39·15	4·68	0·81	35·87	0·67	0·40	11·17	2·70	0·80

The sum is stated to be 100·79, but the numbers as they stand add up only 96·25 (or 4·54 less). The analyst observes that the sum of the silica, oxyd of nickel and water is 91·42 (it is as printed 4·63 less or 86·79), and thence deduces the formula $2\dot{N}i\ddot{S}i+4\dot{H}$=Silica 48·31, $\dot{N}i$ 39·15, $\dot{H}$ 12·54. It hence appears that there is a ty-

pographical error in the statement of the silica of between 4 and 5 per cent. [The mineral is said to occur with a *phosphate* of nickel (see *Conerite*); but the chemist, instead of allowing part of the oxyd of nickel to be combined with the 3·50 of phosphoric and arsenic acids (which might take up 2 per cent), and part of the silica with the alumina, selects out the silica, oxyd of nickel and water, and uses these alone to make out a formula. There is no sufficient evidence that the mineral is not identical with the *nickel-gymnite* of Genth (see Min., p. 286).—D.]

ORTHOCLASE [242, II, III, V, VI].—The feldspar of the zircon-syenite has been analyzed by Dr. C. Bergemann (Pogg., cv, 118) and the view confirmed of its being a soda-bearing orthoclase.

OSTEOLITE [398].—The osteolite of the Kratz mountain near Friedland in Bohemia, a snow-white earthy mineral having G.=2·828 to 2·829, afforded Dürre (Pogg, cv, 155):

$\dot{\bar{\mathrm{P}}}$	$\dot{\mathrm{Ca}}$	$\dddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	Cl	$\dot{\mathrm{H}}$
34·64	44·76	8·89	6·14	0·51	0·79	*tr.*	2·97=98·70

The phosphate is mixed with a silicate; the former contains of the above, $\dot{\bar{\mathrm{P}}}$ 34·64 and $\dot{\mathrm{Ca}}$ 40·985. The silicate has the composition nearly of an epidote, the formula being $\dot{\mathrm{Ca}}^3\dddot{\mathrm{Si}}+2\dddot{\bar{\mathrm{Al}}}\dddot{\mathrm{Si}}$.

PECTOLITE [305, II, III, VI].—Analyses 5, 6, in the author's Mineralogy are of the pectolite of Bergen Hill, New Jersey.

PELICANITE.—This mineral occurs as the base of a granitic rock in Russia, in the government Kiew, and is announced and described by Ouchakoff. (Bull. de St. Petersbourg, No. 369, p. 129, Jour. f. Prakt. Chem. lxxvi, 255, and Kopp's Jahresb. for 1857, 673). It is related to cimolite, a product of decomposition. The color is pale greenish; fracture conchoidal; at the edges translucent. G. = 2·256. B.B. burns white and does not melt even on the edges. Composition:

$\dddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{K}}$	$\dot{\bar{\mathrm{P}}}$	$\dot{\mathrm{H}}$	Quartz
58·90	20·49	0·39	*tr.*	0·50	0·29	0·16	8·35	10·30=99·38

affording the formula $\dddot{\bar{\mathrm{Al}}}\dddot{\mathrm{Si}}^3+2\dot{\mathrm{H}}$.

PEROFSKITE [345, II, IV, VI].—Descloizeaux has found (L'Institut, 1859, 33) that perofskite has two axes of double refraction quite distant, with the bisectrix negative. This was observed on specimens of a brownish yellow color from Zermatt and the Urals; and it is a question whether the black crystals from the Urals, which appear to be monometric, are not pseudomorphs.

PHOSPHORCHALCITE [425, II, VI].—The *Ehlite* from Ehl, has been analyzed by Dr. C. Bergemann and found to contain vanadic acid. His analysis afforded (Jahrb. Min., 1858, 195):

	$\dot{\bar{\mathrm{P}}}$	$\ddot{\mathrm{V}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{H}}$
	17·89	7·34	64·09	8·90
Oxygen,	10·12	1·90	12·98	7·90

PYROPHYLLITE [303, I, V, VI].—A mineral resembling massive pyrophyllite, according to W. J. Taylor (Proc. Ac. N. Sci. Philad., Aug. 1858), but not yet analyzed, containing imbedded quartz crystals, at a coal mine in Schuylkill Co., Pa. It is a tough, whitish mineral with a pearly lustre, somewhat greasy feel, forming a layer not over one-eighth inch thick.

Locality of pyrophyllite in Georgia, see under *Lazulite*.

PYROXENE [158, I, II, V, VI].—The pale green *smaragdite* of the euphotide of the Alps afforded T. S. Hunt (this Jour., [2], xxvii, 348):

$\dddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Fe}}$	$\dddot{\bar{\mathrm{Cr}}}$	$\dot{\mathrm{Ni}}$	$\dot{\mathrm{Na}}$	ign.
54·30	4·54	13·72	19·01	3·87	0·61	*tr.*	2·80	0·30—99·15
		14·22	18·07	2·34				

whence the oxygen ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\dddot{\mathrm{Si}}$, 13·29 : 2·12 : 28·96.

The *traversellite* of Scheerer is a leek-green mineral, having the crystalline form of pyroxene, from Traversella in Piedmont in a mine of magnetic iron. It is softer

this mineral but looks like a slightly altered variety. Composition according Richter (Pogg. Ann., xciii, 109):

$\dddot{\text{Si}}$	$\ddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
52·39	1·21	20·46	7·93	14·41	3·69=100·09

xygen ratio for the $\dot{\text{H}}$, $\dot{\text{R}}$, $\ddot{\text{R}}$, $\dddot{\text{Si}}$, is 3·28 : 12·58 : 0·56 : 27·20. The crystals are ngular prisms, having the faces *i-i*, *i-i* large, and *I* small, with the basal plane *O*. Kön. Sächs. Ges. der Wiss., June 1858, p. 92.) Scheerer regards the mineral example of what he calls *paramorphosis*.

rgom, according to Scheerer (Ber. Kön. Sächs. Ges. der Wiss., June 1858, p. 96) gitic in crystallization. Richter obtained:

$\dddot{\text{Si}}$	$\ddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$
31·79	4·03	7·57	*trace*	18·98	17·40=99·77

g the oxygen ratio for $\dot{\text{R}}$, $\ddot{\text{R}}$, $\dddot{\text{Si}}$, 14·06 : 1·88 : 26·89. The form is a rhombic *I*, with the pyramidal planes +1, −1, +2, −2, and occasionally some others.

ARTZ [145, II, III, IV].—A peculiar form of quartz, from different localities, mostly the rock called melaphyre, has been named by Dr. Jenzsch (Pogg., cv, *Vestan*, under the idea that it is a distinct species, quartz being therefore coned dimorphous. The form given is monoclinic and imperfect unequal cleavage ted to occur in three directions. The angles are stated to be only approxima- Two of them, 95½° and 133°, are very near angles in quartz (R:R and R:$-R$).

TZBANYITE, *R. Hermann* (J. f. pr. Chem., lxxv, 450).—This is a bismuth sembling telluric silver, and from Retzbanya. Color lead-gray, but externally ised and mixed with cerusite and bismuth ochre. In irregular pieces with no of crystalline structure. H.=2·5. G.=6·21. B.B. fumes of sulphurous acid; soda is reduced to a globule of lead and bismuth. Afforded on analysis by R. nann:

O	S	Bi	Pb	Ag	Cu
7·14	11·93	38·38	36·01	1·93	4·22=99·61

g the atomic ratio for the oxygen, sulphur, bismuth, and other metals, 8 : 7 : 3 : 4, making, according to Hermann, a compound of a sulphate and oxysulphuret, the formula [2CuS, PbS+3BiS]+2$\dot{\text{P}}$b$\dddot{\text{S}}$.

TTERITE, *Breithaupt*.—See *Nickel-Gymnite*.

TILE [120, V].—In the vicinity of the lazulite locality, Lincoln Co., Georgia azulite), occur, according to C. U. Shepard (this Jour., xxvii, 36), splendent tic crystals of rutile, some weighing upwards of a pound. One has six gentions.

PONITE.—A hydrous aluminous silicate from the waters at Plombières has been zed by J. Nicklès and designated *Saponite*, a name that has for some time bed to a magnesian silicate. The mineral was found to consist of Silica 42·30, ina 19·20, water 38·54, equivalent to $\ddot{\text{Al}}\dddot{\text{Si}}^3$+12$\dot{\text{H}}$, or near cimolite.—L'Institut, 1318, April 6, 1859.

USSURITE [234, II, IV, VI].—The doubts about saussurite have been well cleared T. S. Hunt (this Jour., [2], xxvii, 336). He shows that three species have confounded under the name—similar in a white or a pale greenish white color, tough compact texture—viz. (1.) Labradorite or a related feldspar; (2.) Epi- ; (3.) Garnet. The original saussurite of the euphotide of the Alps is a lime- ina epidote, having G.=3·25—3·36.

HORLOMITE [342, IV].—A. E. Nordenskiöld has described (Beskrif. Finland Min., rom Jahrb. Min., 1858, 312) a mineral having apparently the characters of lomite under the name of *Iwaarite*. Like schorlomite it is found in Elæolite, trous iron-black resembling black or crystallized melanite, with the streak gray, contains much titanium. It is either in monometric crystals or massive. The sis is not cited in the Jahrbuch. The formula given is $\dot{\text{C}}\text{a}^3\dddot{\text{S}}\text{i}$+$\ddot{\text{F}}\text{e}\dddot{\text{S}}\text{i}$+½TiO, ³, while that written for schorlomite by Whitney is $\dot{\text{C}}\text{a}^3\dddot{\text{S}}\text{i}$+$\ddot{\text{F}}\text{e}\dddot{\text{S}}\text{i}$+$\dot{\text{C}}\text{a}\ddot{\text{T}}\text{i}^2$.

B.B. fuses to a black glass. Comes from Iwaara in the Kunsamo Kirchspiel in Finland.

SCORODITE [419, I].—Lippmann has named a mineral found in small bluish crystals at Schneeberg, *Cobalt-scorodite.* It occurs with hypochlorite and quartz.—Kenngott's Min. Forsch. for 1856, 1857, p. 84.

SERPENTINE (282, I—VI].—Antigorite, shown to be slaty serpentine by G. J. Brush, has since been analyzed by Stockar-Escher with the same result (Kenngott's Min. Forsch., 1856, '7, 72). The mean of two analyses is—

Si	Al	Fe	Mg	H
40·83	3·20	5·84	36·26	12·37=98·86.

Stockar-Escher regards the alumina as replacing the silica.

Kenngott has described under the name of *Vorhauserite*, a mineral from the Fleims Valley in the Tyrol at Monzoni, having the composition of *Retinalite*, but impure with a little oxyd of manganese and iron. It occurs amorphous, of a brown to greenish-black color; weak waxy lustre; yellowish, pale or brownish yellow to brownish streak; H.=3·5; G.=2·45. Analysis by J. Oellacher (Kenn. Min. Forsch., 1856–57, p. 71):

Si	Mg	Fe	Mn	H	
41·21	39·24	1·72	0·30	16·16,	CaCl, Ca³P 0·9=99·59

Retinalite is probably *serpentine* mixed with a little Deweylite.

A pseudomorph after chromic iron occurs in Unst, according to Dr. Heddle (Phil. Mag., [4], xvii, 42).

SMITHSONITE [447, I, III].—Smithsonite from near Wiesloch contains carbonate of cadmium. It has a citron-yellow to wax-yellow color. An analysis in the laboratory of Prof. Bunsen afforded:

ZnC	CdC	CaC	FeC	MgC	Zn, H	ZnS	Sand
89·97	3·36	2·43	0·57	0·32	1·94	0·47	0·45=99·51

SPECULAR IRON.—See *Hematite.*

SPHENE [268, III].—A Vesuvian mineral hitherto referred to the species sphene (the semeline of Fl. de Bellevue) has been described by G. Guiscardi under the name of *Guarinite*, after Prof G. Guarini of Naples. (Zeit. D. geol. Gess. x, 14.) It is stated to occur in *dimetric* crystals, with difficult cleavage. Color honey-yellow. Translucent or transparent. Lustre subadamantine and adamantine on cleavage faces. H.=6—6·5. G.=3·487. Composition:

Si	TiO^2	Ca	Fe, Mn
33·64	33·92	28·01	*trace* = 95·57

The author observes that the composition is near that of the sphene of Piedmont (Greenovite, *Dufr.*).

STIBLITE [142].—An antimony ochre occurs with antimonial nickel-glance and spathic iron near Eisern in the Siegen District, and contains, according to C. Schnabel (Pogg., cv, 146) Ni 0·17, Fe 5·56, H 9·42, along with antimonious acid 84·85. The oxyd of iron is hydrated.

SUNDVIKITE, *A. E. Nordenskiöld* (Beskrif. Finl. Min., and Jahrb. Min., 1858, 318).—An altered anorthite.

TETRADYMITE [21, 512, I].—C. U. Shepard has described (this Jour., [2], xxvii, 39) tetradymite from Lumpkin Co., Ga. It occurs in gneiss. It is associated with gold, pyrrhotine, chlorite, ilmenite in broad curved crystals, and some allanite and apatite. He observes that it is also found at the Pascoe Mine in Cherokee Co., and at a place near Van Wort in Polk Co.

Dr. C. T. Jackson has analyzed the tetradymite of Dahlonega, Georgia, and ascertained that it is the mineral, usually arranged under tetradymite, called bornite. He obtained (this Jour., [2], xxvii, 366):

Te	Se	Bi	Gold (mixed)
18·00	1·18	79·08	0·60 = 98·86

agreeing nearly with the analyses of the Brazilian bornite by Damour. Sp. gravity =7·868.

THERMOPHYLLITE [Suppl. VI].—The thermophyllite of Hoponsuo contains, according to A. B. Northcote (mean of two analyses) Phil. Mag., [4], xvi, 263:

$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$	$\dot{\text{H}}$ expelled at 212° F.
41·48	5·49	1·59	37·42	2·84	10 58	0·30 = 99·70

It is stated to occur in aggregated masses of a brownish gray color and semi-translucent, in some parts micaceous, through a rock of massive thermophyllite; crystalline form not determinable. [It resembles vermiculite in appearance and action before the blowpipe.]

TITANIC IRON.—See *Ilmenite.*

TOURMALINE [270, II, IV].—A fine large pinite-like pseudomorph after tourmaline, three inches long and two in diameter, is described by Mr. Tamnau (Zeits. D. geol. Ges., x, 12). It contains some unaltered black tourmaline. The crystal is a 6-sided prism with the faces also of a 12-sided prism. It was from Rosenbach in Silesia.

VAUQUELINITE [360].—Occurs, according to W. J. Taylor (Proc. Ac. N. Sci. Philad. Aug. 1858), at the Pequa Lead Mine, Lancaster Co., Pennsylvania, in minute crystals with acute terminations, often in radiated aggregations incrusting quartz and galena. The color varies from siskin to apple-green. Small crystals of *cerusite* occur in the cavities of the galena.

VORHAUSERITE, *Kenngott.*—See *Retinalite* under Serpentine.

WAVELLITE [423, IV].—A compound approaching wavellite in composition, occurs, according to A. Gages (Jour. Geol. Soc., Dublin, viii, 73), forming the cement of a conglomerate found as a boulder near Loughhill, county of Limerick. It is composed of small emerald-green crystals mingled with some white ones and forming mamillary concretions. Analysis by A. Gages:

$\dddot{\text{P}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Ni}}$	Fl	$\dot{\text{H}}$	$\ddot{\text{Si}}$	
30·88	36·16	1·81	0·33	*tr.*	23·56	3·61	apatite 1·58, quartz 1·00=98·94

The formula deduced is $(\ddot{\bar{\text{Al}}}, \ddot{\bar{\text{Fe}}})^6 \dddot{\text{P}}^3 + 18\dot{\text{H}}$, but it is stated to be proposed merely as an expression of a single analysis.

On the formula of Kapnicite by Städeler.—Liebig's Ann., cix, 305.

WHITNEYITE, *Genth* (this Jour., [2], xxvii, 400).—Whitneyite is an arseniuret of copper containing about 12 per cent of arsenic, or 1 equivalent of arsenic to 18 of copper =copper 88·37, arsenic 11·63=100. Structure massive crystalline, fine granular. H.=3·5. G.=8·408 (at 16° C.). Lustre metallic; color pale reddish-white; tarnishes readily, becoming yellowish and changing to brown and finally to brownish-black; sometimes iridescent. Somewhat malleable. Composition according to F. A. Genth:

As 11·81	Cu 88·07	Ag and insoluble 0·33=100·21
11·41	88·19	0·47=100·07

B.B. fuses readily, giving off fumes of arsenic. Insoluble in chlorhydric acid; soluble in nitric. Found coated with red copper in Houghton Co., Michigan. One boulder weighing 40 pounds was found at the Pewabic Mine. Stated to occur in a vein four inches wide, about one mile from the Cliff Mine, at the Albion location; also found at the Minnesota mine. Named after Prof. J. D. Whitney, author of the "Mineral Wealth of the U. States."

XENOTIME [401, I, II, III].—The Castelnaudite of Damour, according to a recent analysis (Bull. Géol. [2], xiii, 542, Kopp's Jahresb. for 1857, 686), is xenotime. An analysis afforded Damour $\dddot{\text{P}}$ 31·64, $\dot{\text{Y}}$ 60·40, $\ddot{\text{Ti}}$ and $\ddot{\text{Zr}}$ 7·40, $\ddot{\bar{\text{U}}}$ and $\ddot{\bar{\text{Fe}}}$ 1·20=100·64.

ZINC.—Native zinc has been announced as occurring on the Mittamitta river, Australia, 160 miles northeast from Melbourne. It contains a little cadmium.—Jahrb. Min., 1857, 698.

ZINC-BLOOM [460, 518].—The zinc-bloom of Santander near Comillas in Spain has been analyzed by T. Petersen and E. Voit (Ann. d. Ch. u. Pharm., cviii, 48). The following are their results: (1A) the interior of a mass and (1B) the same after a slight alteration; and also other analyses (2, 3) of the Spanish mineral by Mr. Braun (loc. cit.):

	$\ddot{C}$	Zn	$\dot{H}$
1A.	15·1	73·1	11·8 =100
1B.	13·81	74·73	11·45= 99·99
2.	13·33	73·15	12·96, mixed Calamine 1·34
3.	14·32	73·83	11·87=100·02

The constitution deduced from 1A, is 3Zn, 3$\ddot{C}$, 6$\dot{H}$; from 1B, Zn$\ddot{C}$+2Zn$\dot{H}$.

Analysis of zinc-bloom from a lead mine near Romsbeck in Westphalia by C. Schnabel (Pogg., cv, 144): $\ddot{C}$ 12·30, Zn 64·04, $\dot{C}u$ 0·62, Fe and Al 2·58, $\dot{C}a$ 0·52, $\dot{H}$ 13·59, hygroscopic water 2·02 (by drying in a water-bath), siliceous residue 3·38, Mg, Mn, S *traces*=99·45=$Zn^3\ddot{C}$+3$\dot{H}$.

SCIENTIFIC INTELLIGENCE.

I. PHYSICS AND CHEMISTRY.

1. *On the oxyd of ethylene.*—A. WURTZ has found that when glycol, $C_4H_4O_2+2HO$, is saturated with muriatic acid gas and heated in a closed tube water is set free and a new ether formed. The reaction is represented by the equation

$$C_4H_6O_4+HCl=C_4H_5ClO_2+2HO.$$

The new ether is a colorless neutral liquid soluble in water and boiling at 128°. The author considers this body as between glycol, $C_4H_6O_4$, and the Dutch liquid, $C_4H_4Cl_2$. A solution of potash decomposes the new ether giving chlorid of potassium and the oxyd of ethylene, $C_4H_4O_2$. The oxyd of ethylene—the true ether of glycol—is isomeric with aldehyd. It is a colorless liquid which boils at 13°·5 under a pressure of 746·5: aldehyd boils at 21°. The oxyd of ethylene is soluble in water in all proportions, and gives with bisulphite of soda a crystalline compound. It forms no crystalline compound with ammonia. Perchlorid of phosphorus converts it into Dutch liquid. We have, namely, the equation

$$C_4H_4O_2+PCl_5=C_4H_4Cl_2+PO_2Cl_3.$$

By a similar process Wurtz has prepared the oxyd of propyl-glycol, $C_6H_6O_2$. The relations between the diatomic ethers and aldehyds are best exhibited by the formulas

$$\left.\begin{matrix}C_4H_3O_2\\H\end{matrix}\right\}\text{Aldehyd}\qquad C_4H_4.O_2\qquad\text{Ethylen oxyd}$$

$$\left.\begin{matrix}C_6H_5O_2\\H\end{matrix}\right\}\text{Propionic aldehyd}\ C_6H_6.O_2\qquad\text{Propylen oxyd.}$$

Comptes Rendus, xlviii, 101.

2. *On the chemical constitution of lactic acid.*—KOLBE has brought forward a new view of the constitution of lactic acid which connects this body in a very interesting manner with the acids homologous with formic acid. The author in the first place refers to the fact that the researches of Perkin and Duppa may be regarded as proving that glycocine is amido-acetic acid. By the action of nitrous acid upon glycocine, alanin,

, a series of acids is obtained homologous with lactic acid, and of ch glycolic acid is the first term. Kolbe regards these acids as re-ing from the acids of the formic series by the replacement of one ivalent of hydrogen in the radical by one of peroxyd of hydrogen s. Thus acetic acid being

$$C_4H_3O_3+HO$$

colic acid is $C_4H_2(HO_2)O_3+HO$ and may be termed -acetic acid. In like manner lactic acid is oxy-propionic acid and so Considered as amido-acetic acid glycosin has the formula C_4H_2 $H_2)O_3+HO$. To test the correctness of Kolbe's view Ulrich has ituted experiments to determine whether the acids of the formic series be prepared from those of the glycolic series, and has succeeded in nsforming lactic into propionic acid by a simple process. This consists cting upon lactate of lime by perchlorid of phosphorus by which the rid of chloropropioxyl is formed. Brought into contact with water gives chloropropionic and muriatic acids, according to the equation

$$C_6H_4ClO_2.Cl+2HO=C_6H_4ClO_3,\ HO+HCl.$$

the action of nascent hydrogen chloropropionic acid may be converted propionic acid. By the action of perchlorid of phosphorus upon ate of lime Wurtz obtained a liquid which he termed chlorlactyl and which he gave the formula $C_6H_4O_2Cl_2$. The true constitution of this id appears however from the above. Wurtz's view that lactic acid the formula $C_6H_6O_4$ is bibasic also falls to the ground, if lactic is ly oxypropionic acid. Kolbe further denies that glycol and its homo-ues and glycerin and its homologues are really alcohols, and prefers to fine this term exclusively to the hydrates of monatomic radicals. ording to his view the glyoxylic acid of Debus is dioxyacetic acid, so we have the series

Acetic acid	$C_4H_3O_3$, Ho
Oxyacetic acid	$C_4H_2(HO_2)O_3$, HO
Dioxyacetic acid	$C_4H(HO_2)_2O_3$, HO

ceric acid is then dioxypropionic acid. In like manner anisic acid be regarded as oxytoluic acid. Kolbe suggests that the alcohols and hyds of the oxy-acids are derived from the alcohols and aldehyds of primitive acids by simple replacement of hydrogen by HO_2, exactly the oxy-acids themselves. It must be admitted that his views, to say least, are very ingenious and suggestive.—*Ann. der Chemie und rm.*, cix, 357.

. *On the Compounds of Valeral with Acids.*—Guthrie and Kolbe e obtained combinations of valeral—the aldehyd of valerianic acid— h acetic and benzoic acids. Both of these compounds contain two ivalents of acid to one of oxyd, but are not identical with the isomeric ate and benzoate of amyl-glycol. Guthrie had already obtained a id acetate of common aldehyd. These results all go to prove dis-tly that the ethers of the glycol series are not identical with the alde-s, and fully confirm the results of Wurtz as above stated, (1). They her show, moreover, that the aldehyds in their relations to acids are rable to the type of two equivalents of water and not of two equiva-s of hydrogen.

4. *On the Simple Acetate of Glycol and the preparation of Glycol.*—Atkinson has found that the bromid of elayl is easily decomposed by certain salts of potash. By the action of bromid of elayl upon acetate of potash, the author succeeded in preparing acetate of elayl in considerable quantity. The bromid and acetate are to be dissolved in equal quantities in alcohol of 85 per cent, and the whole, after being well corked, exposed for two days to the temperature of boiling water. The liquid is then to be distilled: that which passes over between 180° and 185° is the simple acetate of glycol $\left.\begin{matrix} C_4H_4 \\ C_4H_3O_2 \\ H \end{matrix}\right\} O_4$. This is a colorless oily liquid heavier than water, and miscible with this and with alcohol. Potash and baryta easily decompose this compound into glycol and an acetate. Instead of the bromid of elayl, chlorid of elayl may be employed in preparing the acetate of glycol; but in this case the mixture must be heated to 100° for three or four days at least. Glycol bears the same relation to the simple acetate of glycol, that a bibasic acid bears to its acid salt.

The author obtained glycol by distilling the acetate with caustic potash. The glycol thus obtained exhibited all the properties of that body described by Wurtz.

5. *On Organic Compounds containing Metals.*—Buckton has obtained several very interesting compounds by the action of metallic chlorids upon zinc-ethyl. Chlorid of mercury acts with great violence upon zinc-ethyl, so that the containing vessel must be cooled by means of water and the well dried chlorid added gradually. The apparatus is then to be warmed, when mercur-ethyl passes over by distillation as a heavy, colorless liquid, almost free from odor. The pure mercur-ethyl C_4H_5Hg boils between 158° and 160° C. It takes fire easily and burns with a luminous, somewhat smoky flame, giving out vapors of mercury. Dilute acids act but little upon it, but concentrated muriatic or sulphuric acids give off ethyl-hydrogen, while the salts of mercur-ethyl, $C_4H_5Hg_2$, remain in solution. The density of the vapor of this compound was found to be 9·97, its calculated density for 2 vols. would be 8·68.

The author also obtained the same compound by the action of zinc-ethyl upon the iodid of mercur-ethyl. By the action of chlorid of lead upon zinc-ethyl, Buckton obtained a radical having the formula $(C_4H_5)_2$ Pb. This substance is a colorless fluid almost free from smell, insoluble in water, soluble in ether; it takes fire easily and burns with a beautiful orange colored flame, with a blue border giving off vapors of oxyd of lead. It appears to be incapable of forming salts without a partial decomposition, but the author obtained a crystalline chlorid and sulphate.

Chlorid of silver acts powerfully upon zinc-ethyl but does not yield a conjugate radical, the products of the action being ethyl, chlorid of zinc and metallic silver. When iodid of stann-ethyl is treated with zinc-ethyl and distilled, a colorless liquid passes over between 170° and 180°, which is a new stann-ethyl having the formula $(C_4H_5)_2Sn$. This body resembles the above mentioned lead compound, but is more stable. It is easily inflammable and burns like tin in the flame of the compound blowpipe. This radical differs in many respects from the stann-ethyl obtained by Frankland, which has the formula C_4H_5Sn. Muriatic acid attacks it with

difficulty; on heating there is a slow evolution of gas, and a chlorid is formed which appears to be richer in tin than the original radical. This chlorid crystallizes with difficulty and has an oily consistency at ordinary temperatures, it has a strong and penetrating smell, and on heating gives off a vapor which is very irritating to the skin. A corresponding bromid also exists, but the other salts are not yet described.

6. *On the Compounds of Organic Radicals with the Metals of the earths.*—HALLWACHS and SCHAFARIK have studied the action of iodid of ethyl upon several of the earthy metals. When magnesium is heated in a closed tube with the iodid, the metal is gradually converted into a white mass. On opening the tube gas is given off, and the white mass on heating yields a colorless volatile liquid, which has a penetrating smell of garlic. The slightest trace of air produces white clouds of magnesia, but the liquid does not take fire spontaneonsly. This liquid consists probably of hydro-carbons with traces of ethyl-magnesium. Finely divided aluminum foil when heated in a closed tube with twice its volume of iodid of ethyl, yields a thick syrupy liquid. On opening the tube a little gas is given off, but every drop of the liquid burns in the air magnificently, with formation of white, brown and violet vapors. The contents of the tube distilled in a current of carbonic acid yield a heavy colorless oil which has a very high boiling point, and which decomposes water most violently. This liquid is doubtless an ethyl-aluminum. The authors propose to extend their investigation to other metals. W. G.

7. *Faraday's Researches in Chemistry and Physics*—(Researches in Chemistry and Physics, by MICHAEL FARADAY, D.C.S., F.R.S., &c., &c.). London: Richard Taylor and William Francis, Printers and Publishers to the University of London. 1859. 496 pp. 8vo, with 3 plates.—The illustrious author of this volume says in his preface, "The reasons which induce me to gather together in this volume the various physical and chemical papers, scattered in the Philosophical Transactions and elsewhere, are the same as those which caused the Experimental Researches in Electricity to be collected into one series." Every student of these sciences will acknowledge a debt of gratitude to England's most distinguished philosopher for this new memorial of a life singularly fruitful of important results in physical science, while every young student will peruse with peculiar interest the early papers of Michael Faraday, written when he was as yet unknown to fame and rejoicing in the friendship and scientific guidance of Sir Humphrey Davy. The first paper, On the Native Caustic lime of Tuscany, appeared in the Quarterly Journal of Science (i, 260) in 1816. To this paper the author adds the following characteristic note.

"Reprint this paper at full length. It was at the beginning of my communications to the public, and in its results very important to me. Sir Humphrey Davy gave me the analyses to make, as a first attempt in chemistry, at a time when my fear was greater than my confidence and both far greater than my knowledge; at a time also when I had no thought of ever writing an original paper on science. The addition of his own comment and the publication of the paper encouraged me to go on, making from time to time other slight communications, some of which appear in this volume. Their transferrence from the 'Quarterly' into other journals increased my boldness; and now that forty years have elapsed and I can look back on what the successive communications have led to, I still hope, much as their character has changed, that I have not, either now or forty years ago, been too bold.—M. F."

The last paper in the present volume is the author's *Lecture on Mental Education*, in which he develops with vigorous thought his views on some of the popular delusions of the day.

II. GEOLOGY.

1. *Third Report on the Geological Survey of South Carolina;* by OSCAR M. LIEBER. 224 pp. 8vo. Columbia, S. C. Price of each Report 50 cents.—This Report treats particularly of Greenville and Pickens Districts. It gives information respecting the topography of the region, and the veins and metamorphic and eruptive rocks, and illustrates the distribution of the rocks on colored maps. A large part of the Report is occupied with a treatise on Itacolumite and the associate rocks, and their connection with the occurrence of gold. The associate rocks are *Specular schist* (a schist made up largely of specular iron), *Itabirite*, a rock consisting of arenaceous quartz and magnetite with some specular iron; *Catawbarite*, a talcose rock or schist with much magnetite; besides also an itacolumite conglomerate, and some limestone. Various reasons are given for believing that the itacolumite series are metamorphic palæozoic rocks. The origin of the gold in auriferous rocks is discussed at considerable length; but to clear up all difficulties connected with the subject, more facts are required than are yet known.

2. *Geological Survey of Canada;* Sir W. E. LOGAN, F.R.S., Director: *Figures and Descriptions of Canadian Organic Remains.* Decades I. and IV. 48 and 72 pp. 8vo, each with 10 plates. Montreal, 1859. B. Dawson.—The publication of the third Decade on the Organic Remains of Canada was announced in our last volume. Quite recently Decade I. has appeared in similar style, and with exquisite steel-plate engravings. This number is by the palæontologist Mr. J. W. Salter of London, while the engravings are by Mr. Sowerby. It takes up a portion of the Lower Silurian mollusks and illustrates the genera and species with great skill, bringing out much that is new respecting them. It represents finely the Maclurea Logani with its operculum, species of Ophileta, Raphistoma, Murchisonia, Cyclonema, Loxonema, Cyrtoceras, Ctenodonta (Hall's Tellinomya, this name being changed with good reason because the species are related not to Tellina or Mya, but to Arca), and others. There is one plate devoted to two species of Receptaculites.

Decade IV. also has just been issued. It is devoted to the Crinoids of the Lower Silurian, and is by Mr. E. Billings. Like the Decade on the Cystids it shows great success in the collection and study of the Canada Echinoderms. About fifty species are here included, five of which belong to the Chazy, and the rest to the Birdseye, Black River, Trenton, and Hudson River formations. The most remarkable species are certain forms of the Chazy, Pentremite-like in structure, for which the genus *Blastoidocrinus* is instituted. Another new genus of the Chazy is called *Palæocrinus*—the species P. striatus. It has five radiating ambulacral grooves on the summit. A second of the same rock is called *Hybocrinus;* and four are described from the Trenton. The species are well illustrated with lithographic plates.

3. *Geology of the Mexican Boundary Survey.*—The first volume of the Mexican Boundary Survey Report contains Geological Reports by Dr.

. C. Parry and Assistant Arthur Schott, with notes by W. H. Emory; Report on the Palæontology and Geology of the Boundary by James Hall: and Description of Cretaceous and Tertiary Fossils by T. A. Conrad, Esq.; and it is illustrated by a Geological Map by Mr. Hall, and numerous 4to plates of fossils by Conrad.

The date of the volume on the title page is 1857, but the true date of publication is the summer of 1858.

4. *Contributions to the Palæontology of New York:* being some of the results of investigations made during the years 1855, '56, '57, '58; by JAMES HALL. 18 pp., 8vo. Albany, 1859.—This pamphlet contains descriptions of three new genera—*Palæarca*, *Megambonia* (near Ambonychia), and *Strophostylus* (a Natica-like univalve), besides a reference of the so-called *Acroculiæ* of the Palæozoic to Conrad's genus *Platyceras*, and a citation of the characters of Conrad's genus *Platyostoma*. The first genus is the same that was called *Cyrtodonta* by Billings in the Canada Geol. Rep. for 1857, p. 179; and Billings's name therefore has the priority. Mr. Hall states that the genus is in the third volume of his Palæontology. Unfortunately the volume is not published; and much more may yet be lost to the author, as priority of *publication* is the only just basis for any claim. Mr. Hall at the same time observes that the genus *Cypricardites* of Conrad was based on a shell probably of similar character. *Cyrtodonta* is of the Arca family, but has little resemblance in its teeth to Arca, there being but a few tooth-like folds at either extremity of the hinge surface; and it is still more remote from Cypricardia; hence both the names *Palæarca* and *Cypricardites* are objectionable. To the genus, are referred the *Edmondiæ* of the first volume of Hall's Palæontology, with *Ambonychia obtusa*, *Cardiomorpha vetusta*, *Modiolopsis ...tus* and *M. subspatulatus* of the same volume.

5. *The Geology of Pennsylvania:* a Government Survey, with a general survey of the Geology of the United States, Essays on the Coal-formation and its fossils, and a description of the Coal-fields of North America and Great Britain; by HENRY DARWIN ROGERS, State Geologist, etc., in two vols. 4to, of 586 and 1046 pages, with numerous maps, plates, and wood-cuts. W. Blackwood & Sons, Edinburgh and London, J. B. Lippincott & Co., Philadelphia. 1858.—The geological survey of Pennsylvania by Prof. Rogers was commenced under the act of the Legislature of the State in the year 1836, and was continued on for six years. Again in 1851 it was resumed with reference to its completion, and continued until the spring of 1855, the limit allowed by the act of 1851.

The publication of the Report has been long and earnestly looked for, and it is a pleasure to see it finally issued in a style so excellent, and with a fullness of illustration and description that meets so well the demands of science and the interests of the State.

Prof. Rogers was aided by a corps of assistants, to the number of twelve through much of the time. In 1836 the assistants, as he mentions in his Preface, were John F. Frazer and James C. Booth. In 1837, they were Messrs. S. S. Haldemann, A. McKinley, C. B. Trego, J. D. Whelpley, with Dr. R. E. Rogers, chemist. In 1838 they were Messrs. H. B. Holl, A. McKinley, C. B. Trego, J. D. Whelpley, J. T. Hodge, R. M. Jackson, J. C. McKinney, P. W. Schaeffer, T. Ward, geologists, and Dr.

R. E. Rogers and M. H. Boye, chemists. In 1839 the corps was nearly the same, Peter Lesley and Dr. Henderson being added, and Messrs. Whelpley and McKinney resigning. In 1840 the corps was the same, with the addition of the draftsman, G. Lehman. In 1841 it was reduced to Messrs. McKinley, Holl, Jackson, Lesley, Boye, and Dr. Rogers. From 1851 the geological assistants were Prof. E. Desor and W. B. Rogers, Jr., and the topographers were Peter Lesley and subsequently A. A. Dalson. In the survey of a state of the extent of Pennsylvania (47,000 square miles in area) a very large part of the material for the Report must have been collected by the assistants; and Prof. Rogers acknowledges their energy and devotion in carrying forward the work.

The volumes take up first the Physical Geography of the State, as an Introductory to the Geology. Part I. treats of the Metamorphic rocks; Part II. of the Palæozoic strata. This second part is subdivided according to the rocks in the series, and under each rock into State Districts, and it occupies 480 pages of the first volume and 665 of the second. The second volume commences with the coal basins of the State, to which over 600 pages are devoted. Part III, some 30 pages in length, takes up the Mesozoic Red sandstone series, of the age of the Connecticut River Sandstone. Part IV. includes discussions of various subjects: (1) the igneous rocks and minerals, veins and ores; (2) the conditions of the physical geography attending the production of the Palæozoic strata of the United States; (3) the organic remains of the State; (4) the laws of structure of the more disturbed zones of the earth's crust; (5) classification of the several types of orographic structure illustrated in the Appalachians; (6) coal fields of the United States and British Provinces; (7) chemical constitution and physical characters of the best known coals of North America; (8) British coal-fields; (9) composition and varieties of coal; (10) methods of searching for, opening and mining coal, pursued in Pennsylvania; (11) American and European coal-fields and coal trade; (12) statistics of the iron trade.

The subject of greatest scientific interest, and that which, apart from the coal itself, is most fully illustrated, is that of the structure of the Appalachians, including the system of folds constituting the great range of mountains and the arrangement of the ridges. The facts bear on the history of all mountain making. A large number of sections illustrating this subject are contained in the second volume. We like the facts far better than the theory adopted to account for them.

The subject of coal is treated from every point of view, topographical, geological, economical, and commercial. A fine large map of the anthracite coal-fields accompanying the work is by Peter Lesley, Esq., of the geological corps connected with the survey.

The work is deficient, as the author acknowledges, in the department of Palæontology. As regards the coal plants, Prof. Rogers was fortunate in having the coöperation of Leo Lesquereux, to whose labors the work is indebted for descriptions of a large number of coal plants and a series of excellent plates illustrating them. The zoological palæontology Prof. Rogers has not undertaken to describe. A few figures are given in the chapter on organic remains, pp. 815 to 829; but they are very unsatisfactory, and are sometimes wrongly named or without any specific names.

The author has left this great department of the survey to future workers. This being so, the author had hardly a broad enough basis for the institution of a new system of nomenclature and of subdivisions for the Palæozoic formations, and especially for diverging in these respects from the New York survey, in which the subdivisions had been founded upon a thorough study of the organic remains. The names of these subdivisions, Auroral, Matinal, Levant, Surgent, and so on, can not be proved to be better than those before adopted. They are founded on the idea of a Palæozoic day, which has had no existence except in the fancy of the writer. This unfortunate framework, about which Prof. Rogers has clustered his facts, is no serious impediment to the geological reader who has a key at hand for comparison.

The work is a great one, worthy of the state which authorized the survey. It contains a vast amount of information in all its departments, and will ever rank among the most important of the reports on the geology of the United States. A large and beautiful geological map of the State accompanies it.

6. *Contributions to the History of Euphotide and Saussurite;* by T. Sterry Hunt (this Journal, [2], xxvii, 336–347).—*Erratum.*—On page 345 in the analysis of saussurite VI. the oxygen of 27·72 of alumina is given as 13·95 instead of 12·95, the true number. This correction being made, the oxygen ratios for the protoxyds, sesquioxyds and silica become 7·62 : 13·73 : 23·25, equal to 1 : 1·80 : 3·05, instead of 1 : 1·93 : 3·05. In this case therefore as well as in analysis VII, there is present a certain excess of protoxyds and silica, corresponding nearly to a tersilicate.

T. S. H.

7. *Cretaceous of New Jersey.*—In the note to page 88 of this volume, it is intended to say, that the fossil leaves of New Jersey were found in the lower part or base of the Cretaceous formation in that state, that is, beneath an extensive range of strata containing acknowledged Cretaceous fossils.

8. *Report of the Exploration of the Country between Lake Superior and the Red River Settlement, and between the latter place and the Assiniboine and Saskatchewan;* by S. J. Dawson, Esq., C. E. 45 pp. 4to. Toronto, 1859. Printed by order of the Legislative Assembly.—Besides important information on the geography of the region referred to, some geological facts of interest are brought out. The Cretaceous formation is shown to occur at a point on the Assiniboine, 150 miles west of Fort Garry. The fossils were sent to Messrs. Meek and Hayden for their opinion; and they state that among them there is an *Ammonites placenta*, a fragment of what was probably an *Inoceramus;* and an *Ostræa* near *O. congesta.* The Ammonite was received from an Indian; the latter two were from a dark shale in situ on the Assiniboine, containing fish scales, and closely resembling the Cretaceous beds No. 2 of Nebraska in Meek and Hayden's section. It is suggested that the Ammonite might have been carried north by the Indians, but in view of the other facts it is improbable. Another lot of specimens, including *Scaphites Nicoletii* and *Nautilus DeKayi*, received from another person, is said to have been found in the bed of the Saskatchewan.

9. *On the Fossil Corals of the Devonian Rocks of Canada West;* by E. BILLINGS, F.G.S. 44 pp. 8vo. (From the Canadian Journal for March, 1859.)—This paper by Mr. Billings contains notices of forty-three species of Devonian corals. He observes that about fifty species are known to occur in the rocks, but a few of them in specimens too imperfect for description. Six of these, he states, are found in the Devonian of Europe, viz. *Favosites gothlandica*, *F. basaltica*, *F. cervicornis*, *F. polymorpha*, and *Heliophyllum Halli*. All but two of the species come from the Corniferous and Onondaga limestones. The paper is illustrated by twenty-nine figures.

10. *On some new Genera and Species of Brachiopods from the Silurian and Devonian Rocks of Canada;* by E. BILLINGS (Rep. Canada Geol. Survey, 1858).—This paper describes and illustrates by figures two genera, *Centronella* and *Stricklandia*. The first includes the *Rhynchonella glans-fagi* of Hall, from the Oriskany sandstone and Corniferous limestone in Canada, and Schoharie grit in New York. It has a loop, like Terebratula; the loop consists simply of two slender lamellæ which extend about one-half the length of the shell, where they unite at an acute angle and then become reflexed towards the beak as a thin plate. The genus *Stricklandia* includes the *Pentameras lens*, *P. liratus*, and *P. lævis* of the Middle Silurian of Britain. Three new species are described; *S. gaspiensis*, *S. canadensis*, and *S. brevis*, all from the Upper or Middle Silurian.

11. *Reports on the Geology, Botany and Zoology of Northern California and Oregon;* made to the War Department by JOHN S. NEWBERRY, M.D., Prof. Geol. and Chem. Columbian College, Washington, D. C. 320 pp. 4to, with numerous plates. Washington.—The Geological and Botanical Reports of Dr. Newberry, noticed in our last volume at page 123, are here collected together and published as a separate volume. On the importance and value of the researches we have already remarked. This fine volume contains, besides the geological and botanical reports, a Zoological Report, including a Report on the Fishes collected on the Survey by Dr. C. Girard; on the Zoology of the route by J. S. Newberry; on the Land Shells by W. G. Binney; and on the Reptiles by S. F. Baird; and there are numerous plates of fossils, plants, fishes, reptiles, quadrupeds, and birds.

12. *Geological Excursion.*—Col. E. Jewett of the N. Y. State Geological Museum, Albany, will make an excursion over the State of New York with such students as may choose to join him, in the course of the month of August. The party will leave Burlington, Vt., on the first Monday of August, visit Keeseville and other localities of the lowest Silurian, Montreal, Niagara Falls, Rochester and Genesee Falls, Syracuse, Utica and Trenton Falls, Schoharie, etc., and be out in all about forty days. Col. Jewett's charges are forty dollars for each student, the student bearing his own expenses. It is an excellent opportunity for any who wish to study geology in the field.

III. ASTRONOMY.

1. *Comets of* 1858.—During the year 1858 eight comets were observed. he 1st was discovered by *Tuttle* of Cambridge, Mass., Jan. 4, 1858, the d by *Winnecke* of Bonn, March 8, the 3d by *Tuttle*, May 2, the 4th by *ruhns* of Berlin, May 21, the 5th (the great comet) by *Donati* of Flonce, June 2, the 6th was Encke's comet on its return, the 7th was Faye's omet on its return, the 8th was discovered by Tuttle, Sept. 8.

2. *First Comet of* 1859.—This comet was first detected on the 2d of pril, 1859, by Mr. Tempel at Venice. Its approximate place at $8^h\ 15^m$ pril 2, was R. A. $14^h\ 30^m$, N. Decl. 71°.

3. *Numbering of the Planetoids or Asteroidal Planets.*—In numbering he planetoids a difficulty has arisen from the fact discovered by Mr. chubert, that the planetoid detected by Mr. Goldschmidt, Sept. 9, 1857, nd mistaken for *Daphne*, is undoubtedly a different body. In the *Annuaire* for 1859 of the French Board of Longitude, the planetoid detected ept. 9, 1857, is numbered (47), and the numbers of all those subsequently discovered is increased by *one*. Mr. LeVerrier objects to this roceeding, on account of the confusion which it occasions, and maintains hat the planetoid of Sept. 9, 1857, should be numbered (56).

Which plan will finally be adopted by astronomers remains to be seen. We incline to that of the Annuaire, as strictly conformed to the old rule f numbering in the order of discovery, and as likely on the whole to roduce the least confusion.

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Marcou's Strictures on North American Geologists.*—Mr. Marcou as issued a pamphlet of 40 pages, purporting to be a reply to the two rticles on his North American Geology by James D. Dana. These two rticles he has cited at length, and something more; for in the second, e has inserted, without any notice of it, nearly a page of matter from is book which the reviewer did not quote. The pamphlet presents no ew basis for his claims, and calls for no reply. We merely quote a ingle paragraph for remark, as it has an editorial bearing. It is introuced after citing Prof. Agassiz's article from page 134 of our last volme, and is as follows:

"Mr. Dana's love of the *truth* and *duty to science* obliged him to decline publishing his article in my favor without alterations, which the author refused to make, not ishing to pass under Mr. Dana's editorial scissors; and Mr. Agassiz was obliged to hreaten the withdrawal of his name from the *Journal* to induce Mr. Dana to modify is views of duty sufficiently to publish the article as it was written."

There was no refusal on the part of Mr. Dana to publish Professor gassiz's reply, and no proposition for editorial curtailment, but only obections to its views, and a request to delay the publication, because Prof. gassiz had not yet read the book under review, and therefore did not now what it contained and could not properly, Mr. Dana thought, write reply to a review of it. Moreover, when Prof. Agassiz insisted upon ublishing (trusting to his knowledge of Mr. Marcou's former publicaions), he at the same time stated that he had not the least objection to Mr. Dana's following him with his criticisms. The sequel has shown

the propriety of Mr. Dana's natural suggestion, and enables us to state, on the best of grounds, that if Prof. Agassiz had known what was in the book in question he would not have written at all. Up to the day of Prof. Agassiz's departure for Europe there has been no interruption of the cordial intercourse that has always subsisted between him and Mr. Dana; and we are confident that if he had not left the country immediately after the arrival of the pamphlet, he would himself have made a statement similar to this, in his own name.—EDS.

2. *Auroral Arch.*—During the display of the aurora borealis seen here on the evening of Friday, April 29, 1859, a well defined luminous arch or belt sprung up, spanning the sky from the western horizon nearly over to the eastern, and passing a little south of our zenith. This was its appearance at 8^h 53^m, when it was fully formed. Ten or fifteen minutes previous it was not visible, and I did not observe the process of formation. Its width was from five to six degrees in the meridional portion, but was not quite uniform or constant throughout its whole extent, and the northern edge was best defined. The westerly portion swung slowly southward while the part for twenty degrees or more about the meridian changed its place so little and so slowly, as to present an uncommonly good opportunity for fixing its place among the stars, and to render exact accuracy in time less important. At 8^h 58^m 0^s, New Haven mean time, the central line of the arch was almost precisely on δ *Leonis*, and so continued for about five minutes. Soon after this, it sailed about three degrees southward, so that the arch was just comprised between δ and θ *Leonis*. By 9^h 18^m it had drifted back and δ was again very near the middle line of the arch. The phenomenon gradually faded from the east westwardly, and by 9^h 38^m all had vanished. During this whole time the sky was clear and there was no secondary arch to embarrass the observer.

It is greatly to be desired that these and other data secured here may be united with like observations made to the north and south of New Haven, in order to determine the altitude and width of the arch. Through the kindness of Professor Loomis a few have reached me, but they are too indefinite to be useful in this respect. Loose observations at Suffield, Conn., combined with those made here seem to indicate a height of much more than 100 miles. Any one within 300 miles of this place who may have any tolerable observations on the arch is earnestly desired to publish them in this Journal, or to send them to me. E. C. HERRICK.

New Haven, Conn.

3. *On Apparent Equivocal Generation;* by H. JAMES CLARK, of Cambridge, Mass. (From the Proceedings of the American Academy, Boston, May 10th, 1859).—At the close of our last social meeting I was asked if I had seen any trace of organization in the globules of the Vibrio-like fibrillæ of the muscle of Sagitta. (See p. 108 of this number). My answer was in the negative. No longer ago than yesterday I was fortunate in discovering the origin of another, or rather of several forms of these pseudo-animate bodies called Infusoria. Whilst watching the decomposition of the inner wall of the proboscis of a young *Aurelia flavidula*, our common jelly-fish, I observed that the whole component mass of cells was in violent agitation, each cell dancing zigzag about

within the plane of the wall. If any one will shake about a single layer of shot in a flat pan he can obtain an approximate idea of the appearance of this moving mass. In a perfectly healthy condition these cells lie closely side by side, and do not move individually from place to place, but yet are active on one side, which constitutes the surface of the stomach, where they are covered by vibratile cilia. As the young Aurelia grows, this wall becomes separated from the outer one, but not completely, for the cells of the two adhere to each other by elongated processes varying in number from one to six or seven. Each cell of the inner wall contains numerous red or brown granules, a few transparent globules, and a single large clear mesoblast. When decomposition ensued, these cells became still farther separated from each other and danced about in the manner which I have just described. The vibratile cilia were not observed to share in this movement; in fact I could not detect their presence, because, no doubt, they had become decomposed and fallen away; but the elongated processes, which heretofore had remained immovable and stiff, lashed about with very marked effect upon the cells to which they belonged, and caused them to change place constantly. At last the inner wall fell to pieces and every cell moved independently and in any direction. If at this time they were placed before the eyes of Ehrenberg or any one of his adherents, he would at once pronounce every cell with a single process a *Monas*; the red or brown granules would be recognized as the stomachs filled with food, the transparent globules as the empty stomachs, and the large mesoblast as the genital organ or propagative apparatus. Those with two processes would be to him a *Chilomonas* or some other genus closely related to it; those with three or four on one side would be the *Oxyrrhis* of Dujardin; and those with six or seven processes the *Hexamita* of the same author. To complete the apparently truthful determinations of these microscopists I would only have to place before them some of these cells which I have found in a state of self-division, each half possessing its genital-like mesoblast. In all their various shapes and actions, and in the mode of self-division there is a remarkable and undistinguishable resemblance to numerous moving bodies which go under the name of Infusoria, and which may be found, unconnected with any living organism, in various kinds of infusions.

4. *Note on the Polarization of the Light of Comets*; by Sir David Brewster, (L., E. and D. Phil. Mag., April, 1859, p. 311).—Although there can be no doubt as to the accuracy of the observations of M. Arago on the indications of polarization discovered by him in the light of the comets from 1819 to 1835, there is nevertheless nothing impossible in the supposition that the light may have been polarized after arriving in the terrestrial atmosphere. In fact, when we consider that light is polarized by refraction in passing through the coats of the eye, that it is polarized by refraction at the four or six surfaces of the object-glasses of an astronomical telescope, and also in passing through the surfaces of its eye-piece, and, lastly, that the light of celestial bodies undergoes a slight polarization by the refraction of the atmosphere, we are compelled to admit that the problem of the existence of polarized light in the light of comets is not solved.

I am not aware that those who have observed traces of polarization in the light of comets have noted the direction of the plane in which it has been polarized; nevertheless without some such observation we cannot discover its cause. If the light be polarized in a plane passing through the sun, the comet, and the eye, we must infer that it is polarized by the *reflexion* of the light coming from the sun; if it be polarized in an opposite plane, the polarization may be due to the *refraction* of the atmosphere. If it be polarized *quaquaversus*, this may be due to three causes; namely, to refraction by the surfaces of the object-glasses and eye-piece, to an imperfection in the annealing of the glass of which the lenses are formed, or to the fact of one or more of the lenses being pinched in their cell. Supposing it to be an effect of the first of these causes, the openings of the object-glasses and eye-piece should be reduced to a central band, which would eliminate the light polarized in an opposite plane, and leave that which is polarized in a plane perpendicular to the direction. By turning the telescope or the lenses, the direction of the polarization would be changed.

If the polarization be produced by a defect in the annealing of the glass of which the lenses are made, as appears to be the case in one of Amici's telescopes mentioned by M. Govi, the existence of this imperfection will be rendered evident by exposing the lenses to polarized light.

If the polarization observed be due to the reflexion of the rays of the sun by the comet or its envelops, small stars will be seen more distinctly through it when the polarized light is extinguished by the application of a Nicol's prism.

Whilst I was investigating the polarization of the atmosphere, I observed the remarkable fact, that when objects situated far off in the open country are rendered indistinct by the interposition of a light mist, a part of their distinctness may be restored by viewing them through a Nicol's prism, which extinguishes all the light polarized by the mist in a plane passing through the sun, the object, and the eye of the observer. The objects thus rendered more distinct and visible were seen through that portion of the mist in which the polarization of the light reflected by them was at its maximum. This method of rendering visible objects rendered indistinct by fogs or mists may, it appears to me, receive important applications in military and naval operations.—*Comptes Rendus*, February 21, 1859, p. 384.

5. *The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Mills of the United States*, with discussion of iron as a chemical element, an American ore, and a manufactured article, in Commerce and in History; by J. P. Lesley, Sec'y of the American Iron Association, and published by authority of the same, with maps and plates. New York: John Wiley, Publisher. London: Trubner & Co. 1859. 8vo, pp. 766.—Mr. Lesley has here done a service which will be highly appreciated by all who know the national importance of the iron industry, as well as by those whose researches lead them to seek in a compendious form all the information on subjects connected with iron, to find which they have hitherto been forced to search through a wilderness of isolated authorities. Being a good geologist, familiar with the geology of Pennsylvania

and practically acquainted with what relates to the subject of iron, he was eminently fitted for the labor he has here performed. The work is divided naturally into two parts. The first is a "Directory to Iron works" in the U. S.; Furnaces and Forges and Rolling Mills. The second part (from the 264th page to the end) is a "Guide to the ores," embracing first, general considerations respecting iron as an element, and next, its ores in the United States.

In both divisions of his work Mr. Lesley has adopted a geographical order as the basis of his arrangements, subdividing the matter however according to subjects. Then in his Directory he tabulates, under the letter A, 120 anthracite blast furnaces in the U.S., of which he gives such particulars about each as are most important to be known. Tables B, E, H, K, enumerate with concise descriptions 650 charcoal furnaces, including also a few (less than 20) raw coal furnaces. Tables C, F, and I comprise the bloomeries and forges in the U. States to the number of 497. Tables D, G, J, are devoted to the rolling mills of the U. States, 224 in number. From a valuable statistical summary in the end of the volume we draw the following facts.

The entire production of raw metal in the U. S. in 1856 was a little over eight hundred thousand tons (812,917 tons), being an increase of 12 per cent from 1854. For the year 1856 the whole iron production advanced only 6 per cent over the previous year, but the anthracite branch of the manufacture reached the aggregate of 394,509 tons, being nearly one-half the whole iron product of the country, and showing an increase of *thirteen per cent* over the previous year, a fact to be explained by the conversion of charcoal furnaces into anthracite furnaces. The industry naturally tends to concentrate itself about the geological centre of fuel in Pennsylvania, a fact shown by the decline of this branch of the iron industry outside of Pennsylvania by an annual rate of over six per cent, which raises the Pennsylvania anthracite annual increase to over *twenty-two per cent.*

The commercial crisis of 1857 has been seen in a most serious falling off in the iron product of 1858, consequent on the sudden arrest of so large a number of railways in progress of construction.

The grand total of iron of all kinds, domestic and foreign, used in the United States in 1856 is set down at 1,330,548 tons, which is distributed thus:

	Domestic.	Foreign.	Total.
Rolled and hammered,	519,081	298,275	817,356
Pig iron,	337,154	55,403	392,557
	856,235	353,678	1,209,913

which results give 70 per cent *domestic* to 30 per cent *foreign* iron. The great fact demonstrated by the statistics collected by the American Iron Association are that we have nearly 1,200 efficient iron works in the U. S., producing annually about 850,000 tons of iron, the value of which in an ordinary year is fifty millions of dollars, of which the large sum of $35,000,000 is expended for labor alone.

Mr. Whitney, in his Metallic wealth of the United States, estimates the iron product of the world at 5,817,000 tons, of which 1,000,000 are set down for the U. S., Great Britain producing that year 3,000,000.

When we remember that so late as 1845 the total product of the Unit States in iron had not reached half a million tons (486,000) and that i 1850 it was only 600,000 tons, it will be seen that the progress in th important industry in the first six years of this decade has been at tl rate of over twenty per centum per annum. The operation of this la of increase will soon, it would seem, put an end to all importation o iron, and points even to an export of this great staple at no distant da The stock and variety of iron ores and coal in the United States is suc as seems adequate to meet the demands of the world as fast as the law of commerce will permit their development.

6. *Mammals of North America:* the descriptions of species bas chiefly on the collections in the Museum of the Smithsonian Institutio by SPENCER F. BAIRD, Assistant Secretary of the Smithsonian Institutio 764 pp., 4to, with 87 4to plates of original figures, illustrating the Gene and Species, and including details of external form and osteology. Phi adelphia, J. B. Lippincott & Co. 1859.—Professor Baird has here plac before the country a comprehensive Treatise on the Mammals or Qua rupeds of the country, well illustrated by plates. And from the colle tions under the author's hands, and our knowledge of his care and abilit we are sure that we now have one branch of American zoology thorough discussed. The first part of this volume has already been noticed in th Journal (vol. xxvi, 142), it consisting of the Report on Mammals in th Pacific Railroad Survey. To this is added the Report on the Mamma of the United States and Mexican Boundary Survey. The descriptio are given with full details, and in the plates there are illustrations rela ing to 161 species. The libraries of the country should be supplied wi this great work.

7. *Rational Cosmology, or the Eternal Principles and the Necessa Laws of the Universe;* by LAURENS P. HICKOK, D.D., Union Colleg New York, 1858.—Rational cosmology comes reasonably within the ran of this Journal, but not the system of Prof. Hickok, which is decided irrational. He claims to educe a philosophy of nature from the emp reason instead of through induction, and has proved the fallacy of th method by educing laws that are not the laws of nature. The autho unwittingly, drew upon the furniture of his own mind, unaware that was defective and had been derived by imperfect reason from the ba earth. Prof. Alexander of Princeton has well set forth the errors of th "Rational Cosmology" in the Princeton Review for April, 1859; an we would commend the article to all interested in the subject. The law of nature when fully learned and understood will appear to the reas like the evolution of one thought. But reason should not deceive its and suppose, because it can perceive this unity, that it can therefore evol of itself the thought and the system of laws.

8. *American Association for the Advancement of Science.*—The ne meeting of the Scientific Association was appointed to be held at Spring field, Mass., commencing with the first Wednesday of August. Pro Stephen Alexander of Princeton is President for the year, and Prof. Ed ward Hitchcock Vice-President.

nopsis of the Fresh-water Fishes of the Western Portion of the f Trinidad, W. I.; by THEODORE GILL. 70 pp. 8vo. H. Bail-ew York City. (From the Annals of the Lyceum of Natural , New York, Vol. VI.)

Votes on North American Crustacea, No. I.; by WM. STIMPSON. 8vo, with 1 plate (from the Annals of the Lyceum Nat. Hist. of rk for March, 1858).—We have barely space to announce the nce of this first part of a systematic account of North American sa. It commences with the Maioids and closes with the Pagurus mong the Anomoura.

D. FORBES: Occasional papers on the theory of glaciers, now first col-d chronologically arranged with a prefatory note on the recent progress ent aspect of the theory. 278 pp. Edinburgh, 1859. A. & C. Black.
IRCHISON: Siluria; the History of the oldest fossiliferous rocks and their ns, with a brief sketch of the distribution of gold over the earth. 3d edi-ndon, 1859. Murray.
OHN FLEMING: The Lithology of Edinburgh. Edinburgh.
TRACY: Studies of the Essex Flora; a complete enumeration of all plants ld within the limits of Lynn, Mass., and the towns adjoining. 88 pp. 8vo.

EDINGS BOSTON SOC. NAT. HIST. 1859.—p. 17, Birds of Florida, continued; ryant.—p. 21, Distribution and habits of the Summer Yellow-bird; *Dr.* -p. 22, Minerals of the gold region of Georgia; *C. T. Jackson.*—p. 23, On w Actinoid Polyps of the Coast of the United States; *Agassiz.*—p. 26, of West Roxbury; *C. Stodder.*—p. 28, A new Helix from Maine; *T. J.* ore.—p. 29, On the corrosive properties of guano; *C. T. Jackson.*—p. 31, the Copper and Silver of the Lake Superior region; *C. T. Jackson.*—p. branchus in the Mohawk River; *J. Lewis.*—p. 34, Note on species of Po-*F. W. Putnam.*—p. 38, On the recent eruption of Mauna Loa; *H. M. Ly-* escriptions of new shells; *A. A. Gould.*—p. 45, Note on minerals formed ngs; *C. T. Jackson.*—p. 47, Note on thickness of the earth's crust; *W. B.* -p. 48, Tuckahoe contains no starch; *C. T. Jackson.*
EDINGS ACAD. NAT. SCI. PHILADELPHIA, 1859.—p. 91, Tooth of a Mastodon ndurus, probably of the same species as the common U. S. Mastodon; also aurus bones from New Jersey; *J. Leidy.*—p. 93, On the species of Nico-*LeConte.*—p. 98, Notes on Coluber calligaster of Say; *R. Kennicott.*—Ichthyological Notices; *C. Girard.*—p. 104, Catalogue of birds of New *T. C. Henry.*—p. 110, Teeth of reptiles and other fossils in the Triassic of ania; teeth near those of Saurichthys and others of Diplodus from a lo-Bethany in Virginia; teeth of Pycnodus, Otodus and Galeocerdo, palate h of Pycnodus and fragments of jaws of Mosasaurus from the Green Sand outh Co., N. J.; *J. Leidy.*—p. 111, Sombrero guano; skull of Ursus Ameri-sociated with bones of Mastodon at Oxford, Miss.; *J. Leidy.*—Eight new of Unionidæ; *I. Lea.*—p. 113, Ichthyological notices; *C. Girard.*—p. 122, rimary divisions of the Salamandridæ; *E. D. Cope.*—p. 128, On the genus mus of Authors; *T. Gill.*—p. 131, Description of Hyporhamphus, a genus allied to Hemirhamphus; *T. Gill.*—p. 132. On Dactyloscopus and Leptos-ro genera of the family of Uroscopidæ; *T. Gill.*—p. 133, Catalogue of Birds l in Western Africa by P. B. Duchaillu; *J. Cassin.*—p. 144, Notes on a col-f Japanese Fishes; *T. Gill.*—p. 151, Descriptions of twelve new species of nionidæ; *I. Lea.*—p. 154, Descriptions of new species of Uniones from and other Southern States; *I. Lea.*—p. 155, Description of a third genus rhamphinæ; *T. Gill.*—p. 157, Ichthyological Notices; *C. Girard.*

Bibliographical Notices by Prof. Nicklès.

& BACHELIER of Paris offer the following works:
se on Optical Physics, by Billet, Professor of Physics in the Scientific Fac-Dijon. Vol. II.—We have already announced Vol. I. of this remarkable

work, which embraces all that relates to the higher optics, to which M. Billet has devoted himself. Vol. II. is quite as important and instructive. The labors of Thomson, Young, and Fresnel have contributed most of the material.

Photographic Chemistry, by Barreswill and Davanne, in 8vo, 2d edition.—Within a few years the first edition of this work, announced by us, has been exhausted and a second edition rendered necessary. The authors have introduced into it all the latest improvements, and it contains many unpublished facts. Following the progress in photography, they have attached great importance to the processes on collodion and on paper, and placed the daguerrotype in the second rank.

Aluminium, its nature, manufacture and applications, by H. St. Claire Deville, in 8vo, 176 pages, with plates.—This important work has been mentioned in our communication on page 126. It contains the whole history of the subject, and communicates many interesting details. Notwithstanding that the French government and private individuals have contributed to the researches on aluminium, Deville informs us that he has sacrificed to it a large part of his personal fortune.

Physiological investigations on the animalcules of vegetable infusions compared with the elementary organisms of plants, by Paul Laurent, inspector of forests, &c. Vol. 2. 4to, with plates. Paris: T. B. Bailliere.—We have announced Vol. 1, which appeared in 1854. This volume, in which micrographic observations play so important a part, treats especially of the elementary organisms of plants. Paul Laurent was for thirty years professor in the forest school of Nancy; he has trained many pupils, and some of them are, like himself, devoted to microscopic studies.

Scientific Essays, by Victor Meunier, in 12 nos. of 212 pages. Vol. 3d.—We have already spoken of this work of popular science, devoted especially to inventions and discoveries which have not been made by those who were properly scientific men. The weekly journal, L'Amis des Sciences, by the same author, is devoted to the same end. It happens at the present moment, that this journal has entered into the great contest between pan-spermists and hetero-genists, and favors the theory of spontaneous generation. Victor Meunier is otherwise a competent man, and was the favorite pupil of the great naturalist Stephen Geoffroy Saint Hilaire.

The Moniteur des Hospitaux.—Medico-Surgical Review of Paris.—This journal, which appears three times a week, is one of the most celebrated medical periodicals of Paris. Its chief editor, N. de Castelnau, occupies an eminent rank in medical criticism. Every week this journal presents a critical "feuilleton" entitled "medical darts," in which the editor, Dr. Toulin, with great spirit attacks charlatanism in matters of medicine and pharmacy, as well as whatever is absurd in cotemporary physicians.

Annals of the Paris Observatory, published by Leverrier. Vol. 4, in 4to. Paris: Mallet & Bachelier.—This important volume is devoted to the theory and to tables of the apparent motion of the sun; it is entirely from the hand of M. Leverrier, who has impressed it with the stamp of his own genius.

Catalytic Force, or Investigations on the Phenomena of Contact, by T. L. Phipson. A pamphlet in 4to of 34 pages.—This work was crowned by the Holland Society of Sciences in 1858. The author examines with much care the phenomena called catalytic; he explains these phenomena on a ground-work of known facts, and he concludes that catalysis exists only in name, and that the force known under the name is a pure fiction.

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[SECOND SERIES.]

XVII.—*Obituary Notices of Brown and Humboldt, Members 'he American Academy of Arts and Sciences;* from the Report the Council of the Academy for 1859.

(Proceedings of the Academy, vol. iv, p. 229 et seq.)

YOND the immediate pale of science, and the circle of its devoted cultivators, the association of the names of HUM-T and BROWN may seem new and strange;—the one, a name iar to the whole civilized world; the other, hardly known arge portion of his educated countrymen. Yet these names together, in the highest place, upon the rolls of almost r Academy of Science in the world; and the common judg-of those competent to pronounce it will undoubtedly be, although these vacant places upon those honorable rolls be occupied, they will not be *filled*, in this, perhaps not in al generations.

›on the death of ROBERT BROWN, which occurred on the of June last, in his eighty-fifth year, it was remarked that, to Humboldt, his name adorned the honorary list of a er number of scientific societies than that of any other ralist or philosopher. It was Humboldt himself who, many ; ago, saluted Brown with the appellation of *Botanicarum Princeps;* and the universal consent of botanists recognized confirmed the title. However the meed of merit in science ld be divided between the most profound, and the most e and prolific minds,—between those who *divine* and those

who *elaborate*,—it will probably be conceded by all, that no one since Linnæus has brought such rare sagacity to bear upon the structure, and especially upon the ordinal characters and natural affinities of plants, as did Robert Brown. True, he was fortunate in his time and his opportunities. Men of great genius, happily, often are, or appear to be, through their power of turning opportunities to good account. The whole herbaria of Sir Joseph Banks, and the great collections which he himself made around the coast of Australia, in Flinder's expedition, and which he was able to investigate upon the spot during the four years devoted to this exploration, opportunely placed in Brown's able hands as it were the vegetation of a new world, as rich as it was peculiar,—just at the time, too, when the immortal work of Jussieu had begun to be appreciated, and the European and other ordinary forms of vegetation had begun to be understood in their natural relations. The new, various, and singular types which render the botany of New Holland so unlike all other, Mr. Brown had to compare among themselves,—to unravel their intricacies with scarcely a clew to guide him, except that which his own genius enabled him to construct in the process of the research,—and to bring them harmoniously into the general system of botanical natural alliance as then understood, and as he was himself enabled to ascertain and display it. It was the wonderful sagacity and insight which he evinced in these investigations, which, soon after his return from Australia, revealed the master mind in botanical science, and erelong gave him the position of almost unchallenged eminence, which he retained, as if without effort, for more than half a century.

The common observer must wonder at this general recognition, during an era of great names and unequalled activity, of a claim so rarely, and as it were so reluctantly, asserted. For brief and comparatively few—alas! how much fewer than they should have been!—are Mr. Brown's publications. Much the largest of them is the Prodromus of the Flora of New Holland, issued fifty years ago, which begins upon the one hundred and forty-fifth page, and which stopped short at the end of the first volume. The others are special papers, mostly of small bulk, devoted to the consideration of a particular plant, or a particular group or small collection of plants. But their simple titles seldom foreshow the full import of their contents. Brown delighted to rise from a special case to high and wide generalizations; and was apt to draw most important and always irresistible conclusions from some small, selected data, or particular point of structure, which to ordinary apprehension would appear wholly inadequate to the purpose. He had unequalled skill in finding decisive instances. So all his discoveries, so simply and quietly announced, and all his notes and observations, sedulously

educed to the briefest expression, are fertile far beyond the eader's expectation. Cautious to excess, never suggesting a ıeory until he had thoroughly weighed all the available objec·ons to it, and never propounding a view which he did not know ow to prove, perhaps no naturalist ever taught so much in 'riting so little, or made so few statements that had to be re·alled, or even recast; and of no one can there be a stronger ;gret that he did not publish more.

With this character of mind, and while carefully sounding his 'ay along the deep places of a science the philosophy and rounds of which were forming, day by day, under his own and few contemporary hands, Brown could not have been a volu·ıinous writer. He could never have undertaken a *Systema Regni 'egetabilis*, content to do his best at the moment, and to take pon trust what he had not the means or the time to verify,—ke his contemporary, DeCandolle who may worthily be com·ared with Brown for genius, and contrasted with him for the ıthusiastic devotion which constantly impelled him to publica·on, and to lifelong, unselected, herculean labor, over all the ɜld, for the general good.

Nor could Brown ever be brought to undertake a *Genera 'lantarum*, like that of Jussieu; although his favorable and leis·rely position, his vast knowledge, his keen discrimination, and is most compact mode of expression, especially indicated him ·r the task. Evidently, his influence upon the progress of Bot·ıy might have been greater, or at least more immediate and .ore conspicuous. Yet, rightly to estimate that influence now, e have only to compare the *Genera Plantarum* of Endlicher ith that of Jussieu,—separated as they are by the half-century hich coincided with Brown's career,—and mark how largely the ɔints of difference between the two, so far as they represent in·ıiry, and genuine advancement in the knowledge of floral struc·ıre, actually originated with him. Still, after making due allow·ıce for a mind as scrupulous and cautious as it was clear and rofound, also for an unusually retiring disposition, which even ı authorship seems to have rendered him as sedulous to avoid ıblicity as most writers are to gain it, it must be acknowledged ıat his retentiveness was excessive; and that his guarded pub·ıhed statements sometimes appear as if intended—like the ana·'ams of the older mathematicians and philosophers—rather to ;cord his knowledge than to reveal it. But this was probably ıly in appearance, and rather to be attributed to his sensitive gard for entire accuracy, and his extreme dislike of all parade ' knowledge,—to the same peculiarity which everywhere led ım to condense announcements of great consequence into short aragraphs or foot-notes, and to insert the most important facts in arentheses, which he who runs over the page may read, indeed,

but which only the most learned and the most reflecting will be apt to comprehend. In candor it must be said, that his long career has left some room for the complaint that he did not feel bound to exert fully and continuously all his matchless gifts in behalf of the science of which he was the most authoritative expositor.

But if thus in some sense unjust to himself and to his high calling, Brown could never be charged with the slightest injustice to any fellow-laborer. He was scrupulously careful, even solicitous, of the rights and claims of others; and in tracing the history of any discovery in which he had himself borne a part, he was sure to award to each one concerned his full due. If not always communicative, he was kind and considerate to all. To adopt the words of one of his intimate associates, "those who knew him as a man will bear unanimous testimony to the unvarying simplicity, truthfulness, and benevolence of his character," as well as to "the singular uprightness of his judgment."

The remaining, and the most illustrious name of all,—and one in its wide renown strongly in contrast with the last,—has only just now been inscribed upon our obituary list.

The telegraph of the last week brought to us the painful intelligence that the patriarch of science, the universal HUMBOLDT, died at Berlin on the 6th of May. Born in 1769, a year more prolific in great men than any equal period of all preceding time,* Humboldt had, before the end of the eighteenth century, exhibited qualities of the very highest order, and obtained a place of acknowledged celebrity in Europe. This, however, was the mere prelude to his career, for with the close of that century he commenced, with Bonpland, his wonderful exploration of Spanish America, which continued during five years. This journey must be considered in all future time as, substantially, the scientific discovery of Spanish America; and whether we measure its results by the amount of knowledge through the wide fields of Astronomy, Geography, Geology, Mineralogy, Meteorology, Zoology, Botany, and Political Economy, or the personal qualities by which this knowledge was collected and reduced to its place in the records of science, we cannot hesitate to rank the expedition amongst the most important and successful ever executed by man.

On his return to Europe, in 1805, Humboldt was employed several years in reducing his immense collection of materials to form for publication. From that time to his death, a period of almost half a century, he resided (except for a short time, in

* Napoleon, Wellington, Mehemet Ali, Soult, Lannes, Ney, Castlereagh, Chateaubriand, Cuvier, and Humboldt. [The name of Metternich is sometimes added to this list, probably incorrectly. That of Canning certainly does not belong here, nor that of Mackintosh, nor of Sir Walter Scott.—EDS.]

which he made his journey to Northern Asia) in Europe, mostly in France and Germany. The last twelve or fifteen years of this great man were principally employed in the production of his *Cosmos*,—the crowning labor of his long life, the harvest of his mature wisdom,—a work that could not have been produced by any other man, simply because no other man possessed the treasures, or a key to the treasures, of the various knowledge contained in it.

From his return to Europe to his death, he possessed, indisputably, the first place amongst philosophers, for the vast extent of his acquirements. Without doubt, at all times during the present century there have been men much greater than Humboldt in each special department of science, but no one to compare with him in the number of subjects in which he had but few superiors,—no one who could, like him, bring all the sciences into one field of view, and compare them as one whole, through their relations and dependences. It was probably this extent of knowledge that led him to generalization rather than particular discovery; to trace connections and relations, rather than to search for new and minute facts or particular laws; to produce the Cosmos, rather than discover the atomic theory or the cellular formation of organic structures. Many other men have been masters of several specialties. Humboldt alone brought the whole range of the physical and natural sciences into one specialty.

We cannot close this brief notice of the character and career of our illustrious associate without one moment's allusion to his amiable moral nature, his love of justice, and his superiority to all merely personal ends. So strong was his desire to give the influence of his high scientific position to the cause of civilization and the progress of knowledge, by assisting all applicants for his opinion and advice upon scientific subjects, that he permitted a correspondence to be extorted from him which in his last days became a load too great to be borne, and compelled a cry for relief that had hardly subsided when the news of his death reached us.

Such is the faint outline of a man whose name is indelibly written with those who have been most eminent in this wonderful age of scientific activity. The Academy claims the privilege, in common with the learned societies with which he was associated throughout the civilized world, to express its sorrow for his death, and to offer its tribute of honor to his memory.

ART. XVIII.—*On the power possessed by the Larves of various common Flies of consuming, without apparent injury to themselves, the flesh of animals which have died from the effects of Arsenic;* by FRANK H. STORER.

Read before the Boston Society of Natural History, January 5, 1859.

SOME months since my attention was attracted by finding several living maggots upon the liver of a subject in the stomach of which I had previously detected the presence of arsenic. This, eight days after death. As this liver was found, on analysis, to be saturated with arsenic, a number of experiments were made for the purpose of ascertaining whether the larvæ observed had really been nourished by the poisoned flesh on which they were discovered.

Several living rats having been obtained, they were fed with cake which contained arsenious acid in various quantities. After eating this they in every case soon died. Their skins having been removed, the carcasses were exposed in a chamber to which flies had free access. In the course of forty-eight hours the bodies of the rats were thoroughly fly-blown, and were soon covered by a multitude of larvæ. Having completely consumed the flesh of the rats—leaving the bones bare, as in the specimen now exhibited to the Society—the maggots concealed themselves in sheltered corners and were converted into chrysalids in due course. These results were constant, having been exactly similar in every instance. Some two dozen or less of these chrysalids being subjected to analysis, metallic arsenic was readily obtained from them. It might be thought that this proves nothing more than that the flesh of the rats contained arsenic, and that, that obtained from the chrysalids had possibly been mechanically attached to the exterior surfaces of the larvæ and not have been swallowed by them. This view would indeed seem to be supported by the fact that—as may be seen in the specimen presented—the surface of the bones from which the flesh has been thus devoured is covered with a white powder which has the appearance of arsenious acid. However this may be, only two alternatives remain if it is not admitted that the arsenic found in the chrysalids had really been assimilated by the larvæ: either the latter must possess an instinct which leads them to reject altogether the poison, or it is excreted by them after injestion. In the lack of any positive knowledge of the condition in which arsenic or other inorganic poison exists when contained in organic tissues, it seems idle to dwell at greater length on this point.

It would have been interesting to have preserved the chrysa-
ls in order to ascertain whether they were capable of meta-
orphosis, and if so, whether the perfect insect would have
en healthy and vigorous. I therefore kept a number of them
ring two months, at the end of which time they were acci-
ntally lost. None of these underwent any change, while a
mber of diminutive flies, apparently not ichneūmons, which
tained access to them, died almost immediately, as was sup-
sed from having fed upon them. The chrysalids were how-
er in a perfect state of preservation, being full of pulp, just
fore they were lost. The empty shells of other chrysalids,
iich had been formed at the same time as the above, were
vertheless found about the room from time to time within the
: weeks following their formation, indicating that some of
em had been metamorphosed, as the appearances of these
ells were normal and no larvæ other than those which had
l upon the arsenicated specimens had been admitted to the
artment.

Numerous experiments were now made for the purpose of as-
rtaining how large a quantity of arsenious acid might be con-
ined in flesh without rendering it unfit food for these larvæ;
thout much success it must be confessed owing to the facility
ith which animal tissue is hardened by arsenious acid. If bits
flesh are soaked in an aqueous solution of this substance—no
atter how dilute the solution may be—the arsenious acid will
iite with the exterior portions of the flesh, forming a com-
ound which, when exposed to the air, dries up in a few hours
the hardness of leather and forms an impervious coating.
his hardening may indeed be somewhat delayed by wrapping
e flesh in moist cloths, in which case the eggs of flies will
ten be deposited. These eggs produce living worms, unless
much arsenic has been used that the surface of the flesh is
vered with a strong solution of it; but these worms never at-
ined maturity in any of my experiments: they perished for
e most part on account of the gradual hardening of the flesh
hich could not be entirely prevented, or from long continued
ntact with the solution of arsenious acid, a thin film of which
as in some instances allowed to cover the surface of the flesh.
n this case the grubs, an hour or two after leaving the egg,
ould commence crawling about very rapidly, evidently much
ritated by the solution with which they were surrounded; this
otion would be kept up sometimes during six or eight hours
efore death ensued.

We all know how quickly flies themselves are destroyed by
rsenic—it being the active ingredient of nearly all the popular
y-papers, powders and poisons of the shops—it is a matter of
o surprise therefore that the parents of the grubs in question

should have perished by scores, as they did while depositing their eggs upon the poisoned flesh. I may here observe that the only reference to this subject which I have been able to find is the remark of Jaeger (quoted by Orfila, *Traitè de Toxicologie*, Paris, 1852, I, 379) that "insects, such as spiders, flies, &c., quickly die when arsenious acid in solution is introduced into their digestive organs or applied to their soft exterior parts. *The larvæ of flies live a little longer than the insects which have undergone metamorphosis.*"

It being impossible to obtain satisfactory results by the method of experimenting which has just been described, I had commenced another series of experiments upon small animals, into the arterial systems of which solutions of arsenic of different degrees of concentration had been injected soon after death. These trials were brought to an abrupt termination by cold weather and the consequent disappearance of all flies. The same difficulties were however experienced here as in the previous cases though in a lesser degree; the flesh having always a tendency to become dry and hard. As this hardening did not take place so rapidly in the injected specimens as where bits of flesh had been soaked in a solution of arsenious acid, so the larvæ were enabled to attain a much larger size, before drying up, than in the previous instances. Indeed in several cases where favorable, moist positions had been secured, they lived for three or four days, becoming quite large and evidently almost ready to pass into the chrysalid state. This, upon the body of a rat weighing seven and a half ounces, into which four and a half grains of arsenious acid in aqueous solution had been injected.

In order to avoid the hardening influence of arsenious acid, solutions of arsenic acid—an eminently hygroscopic substance—were resorted to, but from having been used in too concentrated a state, the larvæ were destroyed, in the course of a few hours after birth, from contact with the solution which had oozed out upon the surface of the flesh; showing clearly, as with arsenious acid, that there is a limit to the amount of arsenic which these larvæ can support.

It is probable indeed that in every case the harmlessness of the poison depends entirely on its being so much diluted that it is no longer present in sufficient dose to destroy the larvæ. I am however inclined to believe that it will be found that they can consume with impunity any flesh into which arsenic has been carried by vital processes. A view which is certainly strongly supported by the fact of finding them upon the arsenicated human liver, an organ which, as is well known, is susceptible of absorbing a particularly large quantity of this poison.

mentioning these results, some time since, to Prof. Jeffries an, he recalled an instance, similar to those which have mentioned, that had occurred a short time before in his dissecting room. The arm of a subject which had been ughly injected with a solution of arsenic acid, having been ertently thrown aside and left unnoticed for several days ound completely riddled and alive with maggots.

is matter is one of some importance to chemists occupied judicial investigations, who must not infer that a fly-blown can contain no arsenic; and is especially interesting from ct that several authors have urged that the attention of ts should be particularly directed to the behavior of flies may alight on any matter suspected of containing poison; y die almost immediately arsenic is probably present and be specially sought for. One case at least is on record Galtier, *Traitè de Toxicologie*, Paris, 1855, I, 406) where the ts having searched in vain for laudanum which was sup- to have produced death, were led to look for arsenic, they found, from having observed that the flies which pon the suspected organs soon perished.

t the subject is also, as it seems to me, worthy the attention is society, as affording another indication of the great dif- es which exist between animals in their several conditions tamorphosis* and of the caution with which all experi- upon the action of remedies or poisons on animals of any pecies should be received when brought forward as indica- of what that action will be upon other animals.

annot refrain, moreover, from calling attention to its obvious bearing upon portant practical question of the destruction of insects injurious to vegeta- ; for it is highly probable that the larvæ of many other insects besides flies susceptible to the action of poisons than the perfect insect. Camphor, for e, is esteemed a preventive of the common clothes-moth, and its vapor is s unpleasant to, if not absolutely destructive of, that insect when in its but- tate; but, as is well known, while it remains a worm it can feed with impu- on woolen stuffs, no matter how thickly they may be strewn with camphor. manner the larvæ of *Dermestes* and *Anthreni*, as proved by the experiments Cabot (Proc. Bost. Soc. of Nat. Hist., vii, 5), can consume bird-skins which en soaked in strong solutions of corrosive sublimate or in a saturated hot of arsenious acid, although they will not touch specimens which have been in an alcoholic solution of strychnine.

ART. XIX.—*On some Reactions of the Salts of Lime and Magnesia, and on the Formation of Gypsums and Magnesian Rocks;* by T. STERRY HUNT, F.R.S., of the Geol. Survey of Canada.*

THE importance, in a geological point of view, of gypsum and of the carbonates of lime and magnesia in the forms of limestone, dolomite and magnesite, has led me to make a series of researches, whose results serve to explain many things hitherto obscure in the history of these substances. I propose in the present paper to describe, in the first place, certain chemical reactions of the salts of lime and magnesia; and, secondly, to consider the principal facts in the history of gypsums, and magnesian rocks, and the theory of their formation.

I.

On the action of solutions of bicarbonate of soda on salts of lime and magnesia.

1. In studying some years since the geological relations of alkaline mineral waters I found that by the action of a solution of carbonate of soda, a partial separation of the salts of lime from magnesia could be effected. Subsequent experiments, made with dilute solutions of bicarbonate of soda, have led me to the following results.

If to a solution containing besides common salt the chlorids of calcium and magnesium in the proportion of one equivalent of each, we add a solution of bicarbonate of soda in water saturated with carbonic acid, there separates a gelatinous precipitate, which very soon becomes crystalline. Collected and washed after a few hours, it is found to consist of carbonate of lime with but a small proportion of carbonate of magnesia, which in three successive precipitations from the same saline liquid, was found to equal 2·20, 2·00, and 1·23 per cent. The proportion of separated carbonate of magnesia diminished as the magnesian salts predominated in the solution, which now gave no further precipitate with bicarbonate of soda, but yielded by evaporation to dryness, a granular residue of hydrated carbonate of magnesia, with very little lime. In this way, a litre of the solution gave 4·19 grams of carbonate of magnesia, (MgO, CO_2) and only 0·14 grm. of carbonate of lime, while the soluble portion still retained in the form of chlorid, 1·176 grms. of magnesia, but no lime.

* The experiments detailed in the first section of this paper, as well as some in the second, have appeared in the Report of the Geol. Survey of Canada for 1857; the others of this section, together with those of the third, are from the forthcoming Report for 1858. See also this Journal, [2] xxvi, 110, and the Canadian Journal for May, 1859, p. 184. Many of the original observations in the fourth section already been published in the Reports of the Survey, but are now for the first time brought together.

2. A portion of the saline solution from which about one-third of the lime had been separated as above by bicarbonate of soda, gave by thirty minutes ebullition, a precipitate which for a litre equalled 0·666 grm. of carbonate of lime and 0·173 of carbonate of magnesia. Another portion of the same solution when evaporated to dryness at 120° F., gave 0·805 of carbonate of lime, but no magnesia.

3. If in the preceding experiments we employ a somewhat dilute solution of bicarbonate of soda there is no immediate precipitation of carbonate of lime. A solution was prepared with one litre of water, 29·2 grms. of sea-salt, 13·8 of chlorid of calcium, 50·7 of hydrated chlorid of magnesium, and 10·0 grms. of hydrated sulphate of soda, the three chlorids being in the proportion of two equivalents of the first and third to one of chlorid of calcium. In another litre of water were dissolved 42·0 grms. (equal to two equivalents) of bicarbonate of soda, and the liquid was then saturated with carbonic acid gas. Of this solution, 500 cubic centimeters would have been required to decompose the whole of the chlorid of calcium in the first, and 200 c. c. of it were gradually added to this with stirring, but without producing any visible effect. A further portion of 100 c. c. caused a slight turbidness, which was soon replaced by a crystalline precipitate, adhering to the sides of the vessel, and gradually increasing in amount. After a repose of forty hours at 68° F., the precipitate was collected and analyzed. It weighed 4·3 grms., and was carbonate of lime, with 3·3 p. c. of carbonate of magnesia.

4. The saline liquid, augmented by the washings of the precipitate, now measured 1·400 c. c.; of this one-half was mingled with 100 c. c. of the alkaline solution, being the quantity required for the decomposition of the remaining lime salt. No immediate change was apparent, but at the end of twenty-four hours there had separated a crystalline precipitate, weighing 2·288 grms., and consisting of carbonate of lime with only 2·6 p. c. of carbonate of magnesia.

5. The reason of this separation of lime from magnesia in the above experiments is evident, when we consider that carbonate of magnesia at ordinary temperatures decomposes the soluble salts of lime. Thus, according to Mitscherlich, magnesite or dolomite slowly transforms a solution of gypsum into one of sulphate of magnesia, carbonate of lime being formed at the same time. I have observed a similar reaction between dolomite and a solution of chlorid of calcium, especially at about 125° F. De Senarmont, and after him Bineau, found that solutions of bicarbonate of magnesia decompose chlorid of calcium in the cold, or at temperatures below 212° F. with precipitation of nearly pure carbonate of line, although the assertion of the latter, that sulphate of lime is decomposed by the same agent, is, as I shall

presently show, not quite correct. The power of decomposing gypsum appears to belong only to solutions containing monocarbonate of magnesia.

6. When a portion of moist recently precipitated hydrocarbonate of magnesia is added to a solution of bicarbonate of lime, it is immediately dissolved, but the transparent solution soon becomes turbid from separation of carbonate of lime. A similar reaction is produced by carbonate of soda, which precipitates carbonate of lime from a solution of the bicarbonate.

7. The preceding experiments show a remarkable degree of solubility in recently formed bicarbonate of lime; the liquid in § 4 deposited spontaneously an amount of carbonate of lime equal to 2·6 grms. per litre; and if we add, as in § 2, 0·8 grms. for the amount of carbonate remaining in solution, we shall have 3·4 grms. of carbonate of lime held for a time dissolved as bicarbonate in a litre of saline water, at the ordinary pressure of the atmosphere; the experiment detailed in § 3, indicates a solubility at least as great.

Boutron and Boudet, by treating lime-water with carbonic acid, obtained supersaturated solutions holding 2·3 grms. of carbonate in a litre, but the half of this was soon deposited, and they found that a litre of water charged with carbonic acid, under a pressure of several atmospheres, cannot retain more than 1·16 grms. of carbonate of lime in permanent solution. We have seen in § 2, that a saline solution retains after some hours exposure, 0·805 grms. of carbonate. In other trials I have found 0·838 and 0·915 grms. of carbonate of lime in pure water saturated with carbonic acid at the atmospheric pressure. A solution prepared under a pressure of several atmospheres with excess of carbonic acid, and then exposed for twelve hours in a loosely covered vessel, still retained 0·730 grms. of carbonate of lime in a litre. Bischof estimates the solubility of bicarbonate of lime at one part in 1000, which may be regarded as correct.

Lassaigne found a saturated solution of bicarbonate of lime to contain six equivalents of carbonic acid for one of lime; but from an experiment of Bischof it would appear, that an amount of lime equal to 0·59 grms. of carbonate to a litre may exist in solution as sesqui-carbonate.—(*Lehrbuch der Geologie*, ii, 1126.)

8. According to the same author, when a current of carbonic acid is passed for a long time through water containing pure magnesia in suspensson, there is dissolved a quantity equal to 1·35 grms. of carbonate of magnesia to a litre.—(*Ibid.*, i, 387.) Under certain conditions, however, water is capable of dissolving an amount of carbonate of magnesia many times greater than that stated by Bischof. In § 1 we have seen that a litre of water, containing at the same time chlorids of sodium and magnesium, may hold dissolved as bicarbonate 4·19 grms. of carbonate of mag-

nesia; and by adding known quantities of carbonate of soda to a solution of chlorid of magnesium and passing a current of carbonic acid through the mixture, I have found it easy to obtain permanent solutions, containing not less than 21·0 grms. of monocarbonate of magnesia in a litre. Bineau, by prolonging for several days the action of carbonic acid, obtained a solution which contained in a litre 11·2 grms. of magnesia (equal to 23·5 grs. of magnesian carbonate), combined with very nearly two equivalents of carbonic acid.

The observations of H. Rose, and of Longchamp, show that the presence of alkaline chlorids, sulphates or carbonates, as well as of magnesian salts, increases the solubility of carbonate of magnesia in water. This may explain the great difference between the determination of Bischof, in which all foreign salts were excluded from the solution, and the experiments of Bineau and myself, with solutions which always contained salts of soda or magnesia. That the presence of such salts does not, on the contrary, augment the solubility of bicarbonate of lime, is apparent from § 2.

9. Bineau found that during the spontaneous evaporation of a solution of bicarbonate of magnesia carbonic acid escaped, and carbonate of magnesia separated, until at length the liquid retained in a litre only from 0·10 to 0·17 grms. of carbonate of magnesia, with sufficient carbonic acid to form a sesquicarbonate. Such solutions, when transferred to closed vessels, were spontaneously decomposed, hydrated carbonate of magnesia separating while a bicarbonate remained in solution.—(*Ann. de Chim. et de Phys.*, [3], li, 302.)

This spontaneous decomposition of the sesquicarbonate of magnesia into monocarbonate and bicarbonate is somewhat analogous to that exhibited by a recent supersaturated solution of bicarbonate of lime, which as we have seen, breaks up into an insoluble monocarbonate and free carbonic acid or a very acid salt. The reaction is observed in a remarkable manner during the evaporation of certain saline mineral waters, which contain abundance of bicarbonate of magnesia. A portion of water from the Plantagenet spring was left to evaporate in an open basin in summer, until its volume was reduced to one-fifth. The clear solution was then decanted from a crystalline crust of carbonates of lime and magnesia, and transferred to a carefully closed flask, where after two or three days, it deposited a strongly adherent crust of hydrated carbonate of magnesia, chiefly on the lower parts of the vessel. The amount of this deposit was equal to 0·772 grms. of carbonate of magnesia to a litre of the concentrated liquid, which contained no lime, but abundance of bicarbonate and chlorid of magnesium, after the separation of the precipitate.

II.

On the reaction between solutions of bicarbonate of lime and the sulphates of soda and magnesia.

10. If to a solution of bicarbonate of lime we add a portion of sulphate of soda or sulphate of magnesia, there are formed by double decomposition, bicarbonate of soda or bicarbonate of magnesia and sulphate of lime, which latter salt may be precipitated by the addition of alcohol.

To 400 cubic centimeters of a recently prepared transparent solution of bicarbonate of lime there were added two grams of hydrated sulphate of soda, and the solution was then mingled with an equal volume of alcohol of 90 p. c. A white flocculent precipitate immediately appeared, which was collected after a few hours, and washed with dilute alcohol. It was completely soluble in water, but was again thrown down by alcohol, with the addition of a few drops of hydrochloric acid, and was pure sulphate of lime, weighing, when ignited, 0·428 grms., which corresponds to 0·915 grms. of carbonate of lime to the litre.

11. 400 c. c. of the same solution of bicarbonate of lime were treated with 2·0 grms. of crystallized sulphate of magnesia and alcohol, as above; the precipitated sulphate of lime equalled 0·467 grm. The filtrate from which the alcohol had been expelled gave by boiling, a copious precipitate containing a little lime and 0·276 grms. of carbonate of magnesia; theory requires 0·288.

12. 500 c. c. of a recent solution of bicarbonate of lime with 2·0 grms. of hydrated sulphate of soda and an equal volume of alcohol, gave a precipitate of gypsum, which when dissolved in water and reprecipitated as in § 10, gave 0·570 of sulphate of lime, equal to ·838 grm. of carbonate of lime to a litre. The alkaline filtrate was evaporated to dryness, the residue redissolved, and precipitated at a boiling heat by a dilute solution of chlorid of calcium. The carbonate of lime thus obtained was free from sulphate, and corresponded to ·445 grm. of carbonate of soda; theory demands ·442.

13. In consequence of this formation of gypsum, the solubility of carbonate of lime in carbonic acid water is, as I have found, very much increased by the presence of sulphate of soda, or sulphate of magnesia. To a little more than 200 c. c. of lime-water were added 4·0 grms. of sulphate of soda, and a stream of carefully washed carbonic acid gas was then passed through the liquid for four hours, at the end of which time the solution of the carbonate of lime was nearly complete. On the addition of an equal volume of absolute alcohol, there fell a precipitate of gypsum, which, when washed, effervesced slightly with hydrochloric acid from a trace of carbonate of lime; but being again thrown down from its aqueous solution by alcohol, gave 0·555 grms. of ignited

sulphate of lime, equal to about 2·0 grms. of carbonate of lime to a litre. The carbonate of soda in the alkaline filtrate was found, by the indirect method of § 12, equal to ·434 grm.; theory requires ·432.

14. In another experiment, a dilute solution of sulphate of soda was treated with an excess of bicarbonate of lime, in order to determine whether it were possible to decompose completely the soda-salt by this means. After throwing down the gypsum by alcohol, the residue contained for a litre 1·080 of carbonate and 0·520 of sulphate of soda.

15. 250 c. c. of water, containing ten grams of hydrated sulphate of soda, and two grams of pure carbonate of lime, were exposed for an hour and a half to a current of carbonic acid gas, and the solution was then left for four hours in a covered flask, after which 150 c. c. of the clear liquid were mixed with an equal volume of absolute alcohol. A copious precipitate was formed, which, after twelve hours, was collected; it was completely soluble in 200 c. c. of water, from which alcohol threw down ·343 grms. of sulphate of lime, besides a farther portion of ·020 grs. from the evaporated filtrate, making a total of 363 grs., equal to 2·420 grs. of sulphate of lime to the litre.

16. 200 c. c. of a similar solution to the last, gave with alcohol, a precipitate of gypsum, which was readily soluble in water, and being thrown down as oxalate, gave an amount of carbonate of lime equal to 1·820 grms. to the litre, or 2·475 of sulphate of lime.

17. A current of carbonic acid gas was passed for an hour and a quarter through a solution containing sulphate of magnesia and carbonate of lime. The filtered liquid remained transparent after many hours exposure to the air; but 200 c. c. of it gave with alcohol a precipitate of gypsum, which was collected after twelve hours and was completely soluble in water, from which solution the lime was thrown down as oxalate, giving an amount of carbonate equal to 1·565 grms. or to 2·128 grms. of sulphate of lime to the litre. The alcoholic filtrate by evaporation to dryness over a water-bath, gave a little carbonate of lime, and an amount of carbonate of magnesia equal to 1·100 grms. to the litre; theory requires 1·312, but it is difficult to separate in this way the whole of the carbonate of magnesia from an excess of sulphate.

18. It thus appears that in the presence of sulphate of soda or magnesia, water saturated with carbonic acid is capable of dissolving nearly twice the ordinary proportion of carbonate of lime, or from 1·565 to 1·820 grms. to the litre. The lime in these liquids is doubtless to be regarded as existing chiefly as sulphate, of which salt they are nearly saturated solutions. The determinations, in § 15, § 16 and § 17, give respectively one

part of sulphate of lime for 413, 404 and 459 parts of water. The solubility of this salt in pure water has been variously stated. According to Bucholz, one part of sulphate of lime requires 460 parts of hot or cold water for its solution; but Giese gives 380 parts of cold, and 388 of boiling water, its solubility being increased, according to O. Henry, by the presence of sulphate of soda.—(Gmelin, *Handbook*, (Cavendish ed.,) iii, 202.)

I determined the amount of sulphate of lime in a solution prepared by agitating frequently for several days, pure artificially prepared gypsum, with distilled water, at 60° F. The lime was thrown down as oxalate, and indicated one part of sulphate of lime to 483 parts of water. Another portion of the same solution was evaporated at a gentle heat until crystals of gypsum separated, and the clear saturated solution decanted from these crystals after twelve hours of repose at 60° F., contained one part of sulphate of lime for 372 parts of water, which approaches closely to the determination of Giese.

19. In a late paper, by Bineau, on the earthy carbonates already cited (*Ann. de Chim. et de Phys.*, [3] li., 297), the author refers to a memoir of Mr. E. Marchand, who asserts that a litre of water may hold dissolved as bicarbonate, about 2·5 grms. of carbonate of lime, and that sulphate of lime and alkaline bicarbonates may co-exist in natural waters. These statements are controverted by Bineau, but the latter of them is fully sustained by the experiments which we have described, while the augmented solubility of the carbonate of lime is to a great extent explained if the solutions of Marchand contained soluble sulphates. I have not however been able to verify the assertion of Marchand, that sulphate of lime separates from mixed solutions of bicarbonate of lime and sulphate of soda, unless indeed by the intervention of alcohol; although as will now be shown gypsum may be crystallized from mingled aqueous solutions of bicarbonate of lime and sulphate of magnesia.

20. When a solution like that of § 17 is evaporated at a gentle heat, it might be expected that carbonate of lime, being a less soluble salt than gypsum, or the carbonate of magnesia, would be deposited. I have found, however, that from such a solution under these conditions, gypsum separates, while bicarbonate of magnesia remains in solution. The sulphate of magnesia employed in the following experiments was carefully recrystallized and contained no traces of lime or free acid; its solution did not alter the color of curcuma, but slowly restored that of reddened litmus. The carbonic acid employed was evolved from limestone hydrochloric acid, and carefully washed, so that its solution was not troubled by nitrate of silver.

To 500 c. c. of water were added twelve grams of sulphate of magnesia and half a gram of precipitated carbonate of lime, and

rent of carbonic acid gas passed for two hours through the d, when the carbonate of lime was nearly all dissolved. The ion was now evaporated in a porcelain basin at a tempera- varying from 90° to 110° F., until crystals of sulphate of iesia separated; a little water was then added and the so- n, being immediately filtered, contained no lime-salt, but strongly alkaline to curcuma paper. When heated it be- turbid before boiling, and after fifteen minutes ebullition sited a flocculent precipitate containing ·208 grm. of carbon- f magnesia. The basin in which the evaporation had been ucted was covered with a crystalline crust which effervesced lightly with hydrochloric acid; it was soluble in a large me of water, and was principally gypsum.

. To 800 c. c. of water were added twenty grams of sulphate iagnesia and one gram of pure carbonate of lime; a current s was now passed through the liquid for an hour and a half, i the lime was nearly all dissolved; the solution was satu- l with the gas, but contained no trace of chlorine. It was ral to curcuma, and gave with alcohol a precipitate of gyp- A portion of it heated to boiling remained clear for five ites, but then grew turbid and deposited an abundant pre- ate of carbonate of lime.

0 c. c. of this solution were evaporated at a temperature of –190° F., until crystals of sulphate of magnesia separated; twelve hours repose in the cold a little water was added the solution decanted from a precipitate, of which ·272 grm. collected; when this was treated with hydrochloric acid and e alcohol a portion of carbonate of lime was removed and remained ·236 grm. of crystalline gypsum, weighing when ed, ·185, equal to ·925 grm. of sulphate of lime to the litre. filtered solution of sulphate of magnesia was strongly alka- to curcuma, and gave by boiling, a precipitate which con- d no lime but a portion of carbonate of magnesia equal to grm. to the litre; theory demands ·570.

. A solution of twelve grams of sulphate of magnesia in c. c. of water was mingled with carbonate of lime and satu- l with carbonic acid. It was then filtered and evaporated out 160° F., until sulphate of magnesia separated. By this is a sparingly soluble crystalline precipitate was formed, h contained gypsum equal to ·235 grm. of sulphate of lime, a little carbonate. The filtrate gave by boiling a precipi- of carbonate of magnesia which equalled ·098, while theory ands ·145.

) 600 c. c. of a solution of bicarbonate of lime were added ty grams of sulphate of magnesia, when the liquid which before turbid from a portion of suspended carbonate, became , and gave by evaporation at 90° F. a precipitate contain-

ing ·154 of sulphate of lime, with some carbonate of lime and a trace only of magnesia.

A solution of five grams of sulphate of magnesia was mingled with a portion of solution of bicarbonate of lime, and evaporated at 160°–180° F., further portions of the latter, amounting in all to 300 c. c. being added as the evaporation went on. There was deposited a mixture of carbonate of lime, with crystalline gypsum equal to ·373 grm. of sulphate of lime to the litre.

23. It will be remarked, that while the recent solution containing gypsum and carbonate of magnesia with excess of carbonic acid is neutral to curcuma and may be boiled for some minutes before a precipitate of carbonate appears, the liquid from which gypsum has been deposited by evaporation is strongly alkaline to curcuma paper, and lets fall a precipitate of carbonate of magnesia, even before attaining the boiling point; this precipitate is in part redissolved as the liquid cools. When this alkaline liquid is mixed with a solution of gypsum, it deposits in a few hours, especially if gently warmed, a crystalline precipitate of carbonate of lime, resulting from the decomposition of the sulphate of lime by the carbonate of magnesia.

The sulphate of magnesia retains the carbonate of magnesia in solution in such a manner that the latter is not rendered completely insoluble, even when the liquid is evaporated to dryness over a water-bath. Hence the deficiency observed in the determinations of carbonate of magnesia in § 17, § 21 and § 22, where a large proportion of sulphate was present. The filtrate from the carbonate in these cases is still alkaline, and gives with nitrates of silver and copper, precipitates of carbonates.

24. In the preceding experiments all salts, other than those concerned in the reaction, were excluded, but similar results are obtained in the presence of sea-salt and chlorid of magnesium. Twenty grams of pure chlorid of sodium, and ten grams of sulphate of magnesia, with a portion of carbonate of lime, were added to 800 c. c. of water, and the solution saturated with carbonic acid gas. Of this liquid 400 c. c. were evaporated at 160°–180° F., until sea-salt separated, and gave ·045 grm. of sulphate of lime, mixed with ·291 of carbonate.

Ten grams of chlorid of sodium, and twenty grams of crystallized chlorid of magnesium were added to 600 c. c. of solution of bicarbonate of lime, containing two grams of sulphate of magnesia; 300 c. c. of this solution were now evaporated at 160°–180° F., until crystals of sea-salt appeared; there were obtained ·057 grm. of sulphate of lime.

25. A saturated solution of one part of sea-salt and two parts of sulphate of magnesia was exposed to a cold of 32° F., when a large amount of sulphate of soda separated. The mother liquor, containing besides some sea-salt and sulphate of magnesia, a

ge amount of chlorid of magnesium, was diluted with four rts of water. 500 c. c. of this solution were mingled with bonate of lime, saturated with carbonic acid, and then evapoed at a temperature of 85°–90° F., to one-twelfth, when crys- s of sea-salt separated, and a crystalline residue of gypsum was ained. It did not effervesce with hydrochloric acid, and was uble in a large volume of water. The saline liquid by evap- tion to dryness, gave ·331 of carbonate of magnesia.

To another portion of 100 c. c. of the saline solution employed the last experiment, 500 c. c. of a solution of bicarbonate of ie were gradually added, the mixture being meanwhile evapoed at a temperature below 100° F., and at length carried to ness. On treating the mass with water, the strongly saline rate was found to contain no lime-salt, but sulphate of lime s abundant in the washings, and the residue on the filter, en treated with hydrochloric acid, left crystalline grains of psum.

26. In the foregoing experiments it is not easy to separate the re soluble salts from the gypsum, which, although insoluble saturated saline liquids, is readily dissolved by washing with ter, in place of which a solution of gypsum may be used. In ner case, as a solution of sulphate of lime is decomposed by dissolved carbonate of magnesia, the washings should not be ngled with the alkaline filtrate in which we wish to determine s salt. As a solution of magnesian carbonate which has lost excess of carbonic acid by evaporation is incompatible with solved gypsum, it is evident that the presence of an excess of s acid must be one of the conditions required for the crystal- ation of gypsum from such a solution. It often happens that ne slight variations in the conditions of the experiment with o portions of the same solution, will give in one case abund- ce of gypsum and in the other chiefly carbonate of lime.

27. The power of bicarbonate of baryta to decompose sulphate magnesia and even sulphate of soda with precipitation of sul- ate of baryta is well known; and I have found that the inso- ility of the sulphate of strontia determines a similar result. solution of bicarbonate of strontia, prepared by passing car- nic acid gas through water holding the carbonate in suspen- n, was divided into two portions, one of which was mingled h a portion of sulphate of soda and the other with sulphate magnesia. The mixtures, at first clear, soon became troubled m the separation of a precipitate, which adhered to the sides of vessels, and like ammonio magnesian phosphate, along the es marked by the rod in stirring. After twelve hours the uids decanted from the precipitate, which was in each case, phate of strontia, were evaporated at a gentle heat to a small lume, during which process they deposited a portion of car-

bonate of strontia. The first contained some sulphate, with a large proportion of carbonate of soda, and the second, which gave no trace of dissolved strontia, let fall by boiling a copious precipitate of magnesian carbonate.

An analogous reaction between the sulphates of iron and zinc and bicarbonate of lime, resulting in the production of gypsum and carbonates of zinc and iron, has already been suggested by Monheim to explain the association of these minerals in a modern deposit from the waters of a mine. The experiments of Bischof have established the fact of such a decomposition for the sulphate of copper, as well as for the sulphates of zinc, and protoxyd of iron.—(*Lehrbuch*, ii, 1198–1202.)

III.

On the formation of the double carbonate of lime and magnesia.

28. The carbonates of lime and magnesia, although so frequently combined in nature in the form of dolomite, exhibit, under ordinary circumstances, little disposition to unite with each other. The carbonate of lime, as we have seen, separates nearly pure, from solutions of bicarbonate of magnesia, at ordinary temperatures; and if by the aid of heat a portion of magnesian carbonate is at the same time precipitated, the two appear to be only in a state of admixture.

Karsten long since observed that dilute acetic acid, at temperatures below 32° F., readily dissolves carbonate of lime, but is without action on the double carbonate of lime and magnesia, which constitutes dolomite. By this means he was enabled to make a proximate analysis of many magnesian limestones, which he found to be mixtures of dolomite with carbonate of lime. Before undertaking a series of experiments on the production of this double carbonate, I endeavored to fix by experiment the limits of error in Karsten's process.

29. For this purpose I took a pure acetic acid, containing 29·4 p. c. of glacial acid; this was mixed with an equal volume of water, so that the dilute acid used in the following experiments contained about 15 p. c. of glacial acetic acid. Unless otherwise specified, it was employed at 32° F. (lower temperatures being difficult to regulate), and this temperature was maintained by a bath of ice and water. In these conditions the acid dissolved precipitated carbonate of lime and pulverized limestone with lively effervescence, even when farther diluted. A pure crystalline dolomite in fine powder was however slowly attacked, subsiding to the bottom of the liquid, and disengaging small bubbles of gas from time to time. After six hours digestion, with a large excess of the acid at 32° F., 1·68 grs. of this dolomite had lost ·082 of carbonate of lime, and ·063 of carbonate

sia, equal to 8·63 p. c. of dolomite, (containing 43·5 p. c. sian carbonate). At a temperature of 60° F., the same sed a slow but continued disengagement of gas bubbles powdered dolomite, which after 30 hours lost 28·0 p. c. ight, the dissolved portion containing 45·0 p. c. of car- f magnesia. At 125° F. the action of the acid upon the d dolomite was accompanied with gentle effervescence, amount dissolved after two hours digestion, was 18·6

te crystalline magnesite from Styria, whose only impu- a portion of carbonate of iron equal to 0·9 p. c. of per- id which was slowly but completely soluble in hot hy- ic acid, was also slightly attacked by dilute acetic acid .; after twelve hours digestion there were dissolved 0·63 the carbonate. At 125° F. however a distinct efferves- s produced with the acid, and at the end of three hours . of the magnesite were dissolved.

these experiments it was evident that although not insol- cetic acid of 15·0 p. c. at 32° F., this liquid might serve te dolomite from carbonate of lime, and also at a higher ure to effect a partial separation of dolomite from mag-

he insolubility of the double carbonate of lime and in carbonic acid water is also an important fact in the f dolomite. Bischof found that by the prolonged action tion of carbonic acid upon a limestone containing 11·54 magnesian carbonate, there were dissolved 4·29 p. c. of e of lime and not a trace of magnesia. In like manner nesian iron-spar, which contained 14·0 p. c. of carbonate nd 15·0 p. c. of carbonate of magnesia, gave to carbonic er four parts of carbonate of lime for one part of magne- onate.—(*Lehrbuch*, ii, 1176.)

ccepting the idea that dolomites have been formed by ration of beds of carbonate of lime, Haidinger long ggested that a solution of sulphate of magnesia at a nperature might produce this change, giving rise by lecomposition to carbonate of magnesia and sulphate of hough Mitscherlich had shown that at ordinary tempera- phate of lime and carbonate of magnesia are mutually sed (§ 5). Von Morlot subsequently verified this con- f Haidinger; he found that by heating together to 200° le, for six hours in a sealed tube a mixture of two equi- f carbonate of lime and one equivalent of crystallized of magnesia, the latter was completely decomposed, production of sulphate of lime and carbonate of magne- h he seems to have regarded as forming with the excess nate of lime a double carbonate.—(Liebig and Kopp,

Jahresbericht, 1848, ii, 500). Desirous of verifying this observation I have repeated the experiment of von Morlot, but have found that although the sulphate of magnesia is indeed completely converted into carbonate, this remains for the most part in the form of magnesite mechanically intermixed with the excess of carbonate of lime, which may be separated by the aid of dilute acetic acid.

32. 100 parts of pure precipitated carbonate of lime (two equivalents) and 123 parts of crystalized sulphate of magnesia (one equivalent) were intimately mingled and exposed in sealed glass tubes for six hours to a temperature of 392° F. (200° C.) The resulting white tasteless mass was treated with cold dilute acetic acid which immediately caused a strong effervescence. When this action had subsided the residue was washed with cold water and then treated with dilute hydrochloric acid which produced no effect in the cold, but by the aid of a gentle heat dissolved a large portion with effervescence. The addition of alcohol threw down abundance of gypsum from the solution, and the filtrate from this being evaporated to dryness and then moistened with hydrochloric acid, was digested with absolute alcohol, by which the chlorids alone were dissolved, leaving a small residue of gypsum, and were found to consist of chlorid of magnesium with but very little chlorid of calcium. The acetic acid on the contrary had dissolved a large portion of carbonate of lime with but little carbonate of magnesia and a little gypsum. Thus in one experiment the acetic solution gave besides ·079 of sulphate, ·523 of carbonate of lime and ·016 of carbonate of magnesia, equal to 3·0 p. c. of the dissolved carbonates, while the portion insoluble in acetic acid, separated from gypsum by the process just described, gave ·459 of carbonate of magnesia and ·017 of carbonate of lime, or 96·3 p. c. of magnesian carbonate. In another experiment there was obtained from the residue insoluble in acetic acid, carbonate of magnesia ·437, carbonate of lime ·020.

The crystallized sulphate of magnesia undergoes the aqueous fusion at about 230° F., and contains sufficient water to render the mixture with carbonate of lime somewhat moist after heating. The above experiment was however repeated with the addition of a portion of water, but with the same result as before; the carbonates not dissolved by acetic acid consisted of ·242 of carbonate of magnesia and ·008 of carbonate of lime.

33. The experiments of de Senarmont have shown that when carbonate of magnesia is formed at a temperature of 150°–175° C. by the reaction between solutions of sulphate of magnesia and carbonate of soda, or by the decomposition of a solution of bicarbonate of magnesia, it separates as a crystalline powder sparingly soluble in acids and apparently identical with magnesite. —*Ann. de Chim. et de Phys.* [3], xxxii, 148. It is evident from

results just detailed that a similar result takes place when bonate of lime is substituted for the carbonate of soda, the bonate of magnesia formed in the presence of an excess of bonate of lime retaining only three or four per cent of this bonate.

14. According to Marignac, when carbonate of lime is heated sealed tubes with a solution of chlorid of magnesium to 200° C. six hours, there is obtained, besides a portion of chlorid of calm, a product consisting of 48·0 parts of carbonate of lime and 0 of carbonate of magnesia; at the end of two hours' heating, proportion of magnesian carbonate was less. (*Bul. Soc. Geol. France* [2] vi, 318.) It does not appear whether Marignac exined the product by the aid of acetic acid, but I find that in process a double carbonate of lime and magnesia is really med.

A mixture of six parts of pure precipitated carbonate of lime h five parts of pure crystallized hydrated chlorid of magnem, dissolved in a little water, was placed in sealed tubes and ted for eight hours to a temperature of 150° C. which was dually raised to 220° C. Two hours after cooling, the matwas removed from the tubes, washed, dried, and treated h dilute acetic acid, which caused a violent effervescence; as n as this had subsided, the filtrate, which contained a large ess of acid and still attacked carbonate of lime with energy, s separated by filtration from the undissolved residue which s but little more than one-fifth of the whole. The dissolved tion consisted in 100 parts of carbonate of lime 96·86, carbonof magnesia 3·14.

35. Previous experiments had shown me that in operating h glass tubes, a portion of silicate of magnesia is always med,* and as this is decomposed by mineral acids, acetic acid s employed in the analysis of the undissolved carbonates, of ich ·800 grm. from the last experiment were treated with acetic

The glass of the tubes is always more or less attacked in these experiments, er alone at the temperature employed dissolving from it a portion of alkaline ate, which by double decomposition with carbonate or chlorid gives rise to a sili- of magnesia. A mixture of carbonates of lime and magnesia with water and onate of soda having been heated for several hours in glass tubes to 150°–170° he greater part of the magnesia was found to be changed into a light flocculent rated silicate insoluble in acetic acid, but decomposed without effervescence by ation with hydrochloric acid, which took up a large portion of magnesia with y a trace of lime, and left granular silica. I have not yet obtained this silicate in cient purity to determine its precise constitution.

When a mixture of magnesite and crystalline quartz was heated for several weeks copper vessel with a solution of carbonate of soda to 180° C. it was found that rly the whole of the quartz had been converted into a hydrous silicate of magneafter decomposing which by sulphuric acid the now soluble silica could be en up by a boiling solution of carbonate of soda. I reserve for another place the lts of a series of researches upon the artificial formation of silicates by the reac- of silica upon carbonates, which as I have elsewhere shown plays a most importpart in the chemical alteration of sedimentary rocks.—*Proc. Royal Society*, and Journal, [2], xxiii, 437.

acid of 15 p. c. at 60° F. No action was apparent even after some minutes, but with a heat of 120° F. a gentle effervescence ensued. When this ceased there remained a flocculent residue equal to 15·7 p. c., and the undissolved portion gave carbonate of lime 37·6, carbonate of magnesia 62·4.

A portion of ·500 grm. of the same carbonates was now digested with dilute acetic acid at 60° F. for several hours. The soluble portion contained carbonate of lime 40·0, and carbonate of magnesia 60·0, while the undissolved residue equalled 22·4 p. c. It effervesced freely with warm somewhat dilute hydrochloric acid and left a silicious residue of ·032 grm., while the dissolved portion gave ·007 of carbonate of lime and ·060 of carbonate of magnesia.

36. In another experiment with carbonate of lime and chlorid of magnesium, the mixture of carbonates as extracted from the tubes contained 24·4 p. c. of magnesian carbonate. This was treated with acetic acid at 60° F., and the digestion continued for some length of time, the result of which was that a large portion of the double carbonate was taken up and the dissolved portion contained 11·4 p. c. of carbonate of magnesia, while the undissolved residue was carbonate of magnesia with but 30·3 p. c. of carbonate of lime, and in a third experiment under similar circumstances contained only 23·6 per cent. These experiments were made before I had determined the solubility of the double carbonate in acetic acid at the ordinary temperature.

It is evident from the above results that these magnesian carbonates, which retain after the action of acetic acid from 23·0 to 37·0 p. c. of carbonate of lime, are mixtures of a double carbonate of lime and magnesia with a less soluble carbonate of magnesian, from which the double salt may be partially separated by the prolonged action of acetic acid at ordinary temperatures, as shown in § 35.

37. In the experiments § 34 and § 36 it appears that the carbonate of magnesia unites, at the moment of its formation, with a portion of carbonate of lime to form the double carbonate. It remained to be seen whether mixtures of the two carbonates would combine directly, and experiments were made with the Styrian magnesite (§ 29) which was mingled in fine powder with carbonate of lime and heated for some hours in sealed tubes to 200° C. with a dilute solution of chlorid of calcium. No combination took place, and the carbonate of lime was afterwards completely removed from the magnesite by cold dilute acetic acid.

The dense insoluble magnesite, as might be conjectured from its occurrence in the products of the previous experiments, exhibits none of that aptitude to combine with carbonate of lime which seems to characterize the newly formed magnesian carbonate before passing into this sparingly soluble condition, a

ange as we have seen in the experiments of de Senarmont 33) takes place at from 155° to 175° C. The hydrated carbon-s of magnesia formed at low temperatures and readily soluble dilute acids, are in like manner, when heated under pressure, prevent the loss of carbonic acid, converted into magnesite; under these conditions carbonate of lime be present the two mbine to form a double salt, possessing the chemical characters dolomite.*

38. In his researches on the double carbonates, H. Deville has scribed an anhydrous crystalline salt composed of one equiva-t each of the carbonates of magnesia and soda. This double bonate is insoluble in cold water, but readily dissolves in tic acid. When it is heated with a solution of chlorid of mag-sium in sealed tubes to 200° C. chlorid of sodium and spar-ly soluble magnesite are obtained. When warmed with a ution of chlorid of calcium this double carbonate is decom-sed and gives rise to a mixture of carbonates of lime and mag-sia readily soluble in acetic acid; at a higher temperature der pressure the two carbonates unite to form a double salt.

39. Three parts of the finely pulverized carbonate of magnesia d soda were added to two parts of chlorid of calcium dissolved a little water and rendered slightly acid by hydrochloric acid. e mixture being placed in hermetically sealed glass tubes, se were heated for some hours in a bath of boiling water with quent agitation, and then in an oil-bath for eight hours, the nperature being slowly raised from 130° to 220° C. On ling, the saline liquid in the tubes was found to contain, be-es chlorids of sodium and calcium, a considerable amount of lorid of magnesium. A portion of the double salt became ted over by the precipitated carbonate of lime and thus pro-ted from the further action of the chlorid of calcium.

The carbonates from the above experiment were treated with a ge excess of dilute acetic acid at 60° F. till effervescence ceased. 0 grm. of the residue were now digested for two hours with ute acid at 60° F.; the action was accompanied with a slow l constant disengagement of carbonic acid gas, and the solu-n gave ·302 grm. of carbonates, of which the carbonate of lime stituted 41·3 p. c. The undissolved portion effervesced with

* I have shown, from a consideration of the densities of the rhombohedral car-spars, that supposing them to possess a common atomic volume, we may rep-nt calcite by $15(C_2M_2O_6)$ while dolomite and chalybite are $18(C_2M_2O_6)$ and gnesite and carbonate of zinc (smithsonite) $20(C_2M_2O_6)$. Farther examples olymerism in mineral compounds are seen in sillimanite and cyanite, in meionite zoisite (saussurite), and in hornblende and pyroxene. These latter, accepting late analyses of Rammelsberg, may be represented respectively by $25(SiMO_3)$ $28(SiMO_3)$, wollastonite being $22(SiMO_3)$; these formulas correspond to e types of homœomorphous isomeric silicates. (See this Journal, [2], xvi, 203, *Comptes Rendus de l'Acad.* 1855, xli, 79.)

warm hydrochloric acid, which dissolved ·178 of carbonates containing only 12·3 p. c. of carbonate of lime, leaving ·116 grm. of insoluble silicious residue.

40. In a repetition of the above experiments the carbonates were treated with acetic acid at 32° F. till effervescence ceased, and a portion of the remaining double carbonate was digested for some time with acetic acid at 125° F. which took up 80·0 p. c. of carbonates containing 38·4 p. c. of carbonate of lime. The insoluble portion did not effervesce with hydrochloric acid, which however removed from it a portion of magnesia but no lime, and left a silicious residue. Another portion was digested for several hours with acetic acid at 60° F. which took up 78·0 p. c. of carbonates containing 40·8 of carbonate of lime. The insoluble residue effervesced freely with warm sulphuric acid, which dissolved a portion of magnesia but no trace of lime.

41. Other experiments were made in which carbonate of lime was mingled with solutions of sulphate of magnesia and carbonate of soda, so that carbonate of magnesia would be formed, the sulphate of magnesia being in slight excess in one case and the alkaline carbonate in another. In another experiment, a mixture of ter-hydrated carbonate of magnesia and carbonate of lime with water and carbonate of soda, was employed. All of these were heated in metallic tubes to from 130° to 200° C. and the products digested for a long time with acetic acid at 60° F. These experiments were made at a time when I had not determined the solubility of the double carbonate under such conditions, and the consequence was that the residues obtained were chiefly carbonate of magnesia, which was scarcely attacked by cold acids, but retained in the form of the double salt from six to eleven per cent of carbonate of lime. In another trial, however, a mixture of hydro-carbonate (*magnesia alba*) and carbonate of lime with water and an excess of bicarbonate of soda was exposed in the boiler of a steam engine to a temperature of from 120° to 130° C. for several hours every day during ten weeks. The washed residue was then digested with acetic acid only until effervescence ceased; after which it was completely soluble in hydrochloric acid, and gave carbonate of lime 46·3, carbonate of magnesia 53·7.

42. The preceding experiments show that carbonate of magnesia, whether (1) as magnesia alba in presence of excess of carbonic acid, from bicarbonate of soda, or (2) a ter-hydrated carbonate, or (3) as precipitated by bicarbonate of soda from sulphate of magnesia, or (4) by carbonate of lime from a solution of chlorid of magnesium at an elevated temperature, or (5) as separated from the double carbonate of magnesia and soda by a solution of chlorid of calcium, will in the presence of water unite directly with carbonate of lime to form a double carbonate of lime and

magnesia, sparingly soluble in cold dilute acetic acid. This combination takes place between 130° and 200° C., at which temperatures the magnesian carbonate tends to pass into the still less soluble state of magnesite, in which, as we have shown, it no longer shows any disposition to unite with carbonate of lime. Hence it happens that in all our experiments a portion of magnesite is mingled with the dolomite, and cannot be completely separated from it. Dilute acids slowly attack both, but unequally, so that we finally obtain a residue which contains carbonate of magnesia free from lime: but the solution having taken up a portion of magnesite, contains more magnesia than is required to form a dolomite with the carbonate of lime; so that we have from 53·0 to 60·0 p. c. of magnesian carbonate instead of 45·0 as in pure dolomite. In nature the combination of the two carbonates has doubtless taken place slowly, and necessarily at the lowest temperature, which is probably much below 130° C., so that we may suppose that it is only in the absence of a sufficient quantity of carbonate of lime that a portion of the magnesian carbonate has been converted into magnesite.

(*To be concluded in the next No.*)

ART. XX.—*Extract from the concluding part of a Memoir on the Botany of Japan, in its Relations to that of North America, and of other parts of the Northern Temperate Zone;* by ASA GRAY.*

IT is interesting to notice that, notwithstanding the comparative proximity of Japan to Western North America, fewer of its species are represented there than in far distant Europe. Also,—showing that this difference is not owing to the separation by an ocean,—that far more Japanese plants are represented in Eastern North America than in either. It is, indeed, possible that my much better knowledge of American botany than of European may have somewhat exaggerated this result in favor of Atlantic North America as against Europe, but it could not as against Western North America.

If we regard the identical species only, in the several floras, the preponderance is equally against Western as compared with Eastern North America, but is more in favor of Europe. For the number of species in the Japanese column which likewise occur in Western North America, is about 120: in Eastern North America, 134; in Europe, 157.

Of the 580 Japanese entries, there are which have corresponding

European representatives, a little above	8.48	per cent of identical species,	0.27
Western N. American representatives, about	0.37	" " " "	0.20
Eastern " " "	0.61	" " " "	0.23

* Extracted from the Memoirs of the American Academy of Arts and Sciences, new series, vol. vi.

So geographical continuity favors the extension of identical species; but still Eastern North America has more in common with Japan than Western North America has.

The relations of this kind between the floras of Japan and of Europe are obvious enough; and the identical species are mostly such as extend continuously—as they readily may—throughout Russian Asia, some few only to the eastern confines of Europe, but most of them to its western borders. To exhibit more distinctly the features of identity between the floras of Japan and of North America, and also the manner in which these are distributed between the eastern and the western portions of our continent,—after excluding those species which range around the world in the northern hemisphere, or the greater part of it, or (which is nearly the same thing in the present view), which are unknown in Europe,—I will enumerate the remaining peculiar species which Japan possesses in common with America:—

In Japan.	*In W. N. America.*	*In E. N. America.*
Anemone Pennsylvanica		A. Pennsylvanica
(Coptis asplenifolia?)	C. asplenifolia	
(Trautvetteria palmata)	T. palmata	T. palmata
Caulophyllum thalictroides		C. thalictroides
Diphylleia cymosa		D. cymosa
Brasenia peltata	[B. peltata]	B. peltata
Geranium erianthum	G. erianthum	
Rhus Toxicodendron	R. Toxicod., var.	R. Toxicodendron
Vitis Labrusca (Thunb.)		V. Labrusca
Thermopsis fabacea	T. fabacea	
Prunus Virginiana?		P. Virginiana
Spiræa betulæfolia	S. betulæfolia	S. betulæfolia
Photinia arbutifolia, in Bonin.	P. arbutifolia	
Pyrus rivularis?	P. rivularis	
Ribes laxiflorum	R. laxiflorum	
(Penthorum sedoides, China)		P. sedoides
Cryptotænia Canadensis		C. Canadensis
Heracleum lanatum	H. lanatum	H. lanatum
(Archemora rigida?)		A. rigida
(Archangelica Gmelini)	A. Gmelini	A. Gmelini
Cymopterus littoralis?	C. littoralis	
Osmorrhiza longistylis	O. longistylis	O. longistylis
Echinopanax horridus	E. horridus	
Aralia quinquefolia		A. quinquefolia
Cornus Canadensis	C. Canadensis	C. Canadensis
Viburnum plicatum		V. plicatum (lantanoides
*Achillea Sibirica	*A. Sibirica	
*Artemisia borealis	*A. borealis	*A. borealis
Vaccinium macrocarpon	V. macrocarpon	V. macrocarpon
Menziesia ferruginea	M. ferruginea	M. ferruginea
(Boschniakia glabra?)	B. glabra	
*Pleurogyne rotata	*P. rotata	*P. rotata

pan.	*In W. N. America.*	*In E. N. America.*
anadense ?)		A. Canadense
m Bistorta	P. Bistorta	
sicarioides	R. persicarioides	R. persicarioides
ifolia		L. liliifolia
hioglossoides		P. ophioglossoides
	I. setosa	
ectum, var.		T. erectum
trifolia)		S. trifolia
im giganteum		P. giganteum
s roseus)	S. roseus	S. roseus
viride	V. viride	V. viride
hioides	J. xiphioides	
ria)		C. Iria
ata		C. rostrata
ta	C. stipata	C. stipata
rocephala	C. macrocephala	
elongatus	S. elongatus	S. elongatus
abra	A. scrabra	A. scabra
uciflora	F. pauciflora	
pedatum	A. pedatum	A. pedatum
nsibilis		O. sensibilis
cinnamomea		O. cinnamomea
m lucidulum		L. lucidulum
im dendroideum)	L. dendroideum	L. dendroideum

ames enclosed in parentheses are of species which I seen from Japan; some of them inhabit the adjacent ; some are imperfectly identified. Those marked * are hern species in America.

e 56 extra-European species, 35 inhabit Western, and rn North America. And 15 are Western, and not 21 Eastern and not Western; and 20 common to both he continent. Eight or ten of these 56 species extend into the interior of Asia.

other hand, the only species which I can mention as igenous both to Japan and to Europe, but not recorded g through Asia, are

latifolius,	Fagus sylvatica,	Blechnum Spicant,
dioica,	Streptopus amplexifolius,	Athyrium fontanum.
dia,		

f these species extend across the northern part of the n continent, and on to the Asiatic; another occurs on west coast of America; and another, the *Fagus*, is rep- in Eastern America by a too closely related species. worthy, that not one of these seven plants is of a pecu- ropean genus, or even a Europæo-Siberian genus;— the fifty-six species of the Americo-Japanese region n Europe, twenty are of extra-European genera; seven-

teen are of genera restricted to the North American, East Asian, and Himalayan regions (except that *Brasenia* has wandered to Australia); fourteen of the genera (most of them monotypic) are peculiar to America and Japan or the districts immediately adjacent; one is peculiar to our northwest coast and Japan; and eight are monotypic genera wholly peculiar (*Brasenia* excepted) to the Atlantic United States and Japan. Add to these the similar cases of other American species (nearly all of them peculiarly Atlantic-American) which have been detected in the Himalayas or in Northern Asia,—such as *Menispermum Canadense* (*Dauricum*, DC.), *Amphicarpæa monoica? Clitoria Mariana, Osmorrhiza brevistylis, Monotropa uniflora, Phryma leptostachya, Tipularia discolor?* &c.,—and it will be almost impossible to avoid the conclusion, that there has been a peculiar intermingling of the Eastern American and Eastern Asian floras, which demands explanation.

The case might be made yet stronger by reckoning some subgeneric types as equivalent to generic in the present view, and by distinguishing those species or genera which barely enter the eastern borders of Europe; e. g. *Cimicifuga fœtida, Mœhringia lateriflora, Geum strictum, Spiræa salicifolia,* &c.

It will be yet more strengthened, and the obvious conclusion will become irresistible, when we take the nearly allied, as well as the identical, species into account. And also when we consider that, after excluding the identical species, only 15 per cent of the entries in the European column of the detailed tabular view are in italic type (i. e. are *closely* representative of Japanese species); while there are 22 per cent of this character in the American column.

For the latter, I need only advert to some instances of such close representation, as of

Trollius patulus	by	*T. Americanus,*
Aquilegia Burgeriana	"	*A. Canadensis,*
Rhus vernicifera	"	*R. venenata,*
Celastrus scandens	"	*C. articulatus,*
Negundo cissifolium	"	*N. aceroides,*
Sophora Japonica	"	*S. affinis,*
Sanguisorba tenuifolia	"	*S. Canadensis,*
Astilbe Thunbergii & Japonica	"	*A. decandra,*
Mitchella undulata	"	*M. Repens,*
Hamamelis Japonica	"	*H. Virginica,*
Clethra barbinervis	"	*C. acuminata,*
Rododendron brachycarpum	"	*R. Catawbiense,*
Amsonia elliptica	"	*Tabernæmontana,*
Saururus Loureiri	"	*S. cernuus,*

and many others of the same sort,—several of which, when better known, may yet prove to be conspecific; while an equally

ır could be indicated of species which, although more fferent, are yet no less striking counterparts.

ıstrate the former proposition, I have only to con- ;ra-American genera common to Europe and Japan ;ra-European genera common to North America and ə principal European genera of this category are *nedium*, *Chelidonium*, *Malachium*, *Lotus*, *Anthriscus*, *rula*, *Rubia*, *Carpesium*, *Ligularia*, *Lampsana*, *Picris*, *juga*, *Thymus*, *Nepeta*, *Lamium*, *Ligustrum*, *Kochia?* *sium*, *Buxus*, *Mercurialis*, *Cephalanthera*, *Paris*, *As-* › which may as well be added *Pæonia* and *Bupleurum*, having a representative on the mountains, and the arctic regions, of Western America, but both absent ıt of our continent. Excepting *Pæderota* and *Buxus* a rather doubtful native of Eastern Asia), none of ı are peculiar to Europe, but all extend throughout ›ewhere over large parts of the world.

wing incomplete list of North American genera or pe- ›neric types represented in Japan and its vicinity, but ı Europe, presents a very different appearance. Those bsent from the flora of Western North America are

	Philadelphus	*Asarum* § *Heterotropa*
arely reaches	*Penthorum*	*Phytolacca*
	Hammelis	*Benzoin* & *Sassafras?*
	Liquidambar	Tetranthera
	Cryptotænia	*Saururus*
fenispermum	Cymopterus?	*Pachysandra*
	Archemora	*Laportea*
n	Osmorrhiza	*Pilea*
	Aralia & § *Ginseng*	*Bœhmeria*
	Echinopanax	*Microptelea*
	Diervilla	*Maclura*
	Mitchella	*Juglans*
Gordonia?)	*Oldenlandia*	Abies § Tsuga
,	(Siegesbeckia, in Mexico)	Chamæcyparis
	Cacalia (reaches E. Europe)	Torreya
	Gaultheria	*Arisæma*
	Leucothoë	Arctiodracon
	Pieris	*Pogonia*
	Clethra	*Arethusa*
	Menziesia	*Dioscorea*
	Symplocos	*Aletris*
	Ardisia	*Coprosmanthus*
	Boschniakia	Trillium
	Catalpa	Clintonia
	Tecoma	Streptopus § Hekorima,
	Dicliptera	*Chamælirium?*

Photonia	*Leptandra*	Sporobolus
Astilbe	*Callicarpa*	*Arundinaria*
Mitella	*Cedronella*	Adiantum
Hydrangea	*Amsonia*	*Onoclea*
Itea		

Here are about 90 extra-European genera or forms, 64 of which are absent from Western North America out of the tropics (the latter comprising a very large part of the most striking representative species), and almost as many more are divided between North America and extra-tropical (chiefly Northern and Eastern) Asia. About 40 of the latter are genera or groups of single, or else of two or few closely related species, peculiar, or nearly peculiar, to the regions just mentioned.

This list should be supplemented by those additional North American genera which have one or more closely representative species in the Himalayan region only, such as *Podophyllum*, *Pyrularia*, &c.; and also by the numerous cases in which Eastern American plants are represented in the Himalayo-Japanese region by strikingly cognate, although not congeneric species; such as our *Macrotys* by *Pityrosperma*; *Schizandra* by *Kadsura* and *Sphœrostema*; *Neviusia* by *Kerria* and *Rhodotypus*; *Calycanthus* by *Chimonanthus*; *Cornus florida* by *Benthamia*; *Prosartes* by *Disporum*; *Helonias* by *Heloniopsis*; and so of others, which have been mentioned in the former part of this memoir, and exhibited in the accompanying tabular view.

I had long ago, in Silliman's Journal, presented some data illustrative of this remarkable parallelism, and also more recently in my "Statistics of the Flora of the Northern United States" (vol. xxii, second series); where I had noticed the facts,—1. that a large percentage of our extra-European types are shared with Eastern Asia; and 2, that no small part of these are unknown in Western North America. But Mr. Bentham was first to state the natural conclusion from all these data,—though I know not if he has even yet published the remark,—viz., that the interchange between the temperate floras even of the western part of the Old World and of the New has mainly taken place *via* Asia. Notwithstanding the few cases which point in the opposite direction (e. g. *Eriocaulon septangulare*, *Spartina*, *Subularia*, *Betula alba*), the general statement will be seen to be well sustained. Also, in the Journal of the Proceedings of the Linnæan Society, 2. p. 34, Mr. Bentham "calls to mind how frequently large American genera (such as *Eupatorium*, *Aster*, *Solidago*, *Solanum*, &c.) are represented in Eastern Asia by a small number of species, which gradually diminish or altogether disappear as we proceed westward toward the Atlantic limits of Europe; whilst the types peculiar to the extreme west of Europe (excluding of course the Arctic flora) are wholly deficient in America.

are among the considerations which suggest an ancient
uity of territory between America and Asia, under a lati-
r at any rate with a climate, more meridional than would
ted by a junction through the chains of the Aleutian and
rile Islands."
ll presently state why connection in a more meridional
e need not be supposed.
deficiency in the temperate American flora of forms at all
r to Western Europe is almost complete, and is most
gly in contrast with the large number of Eastern Ameri-
ms repeated or represented in Eastern Asia. Of genera
l between Eastern North America and Europe, I can
n only *Ostrya*, *Narthecium*, *Psamma*, the maratime *Cakile*,
rhaps *Scolopendrium*. *Hottonia* might have been added,
a species accredited to Java. And if we extend the
across our continent, we add only *Cercis* and *Lœflingia*.
ampler genera at all characteristic of the European flora,
numerate from the Flora of the Northern United States
g more important than *Helianthemum* and *Valerianella*,
three species of each, (but those of the former hardly
ers of the European ones,) adding that *Hieracia* and per-
irsia are somewhat more plentiful in Eastern than in
n America. Let it also be noted, that there are even
Western-European types in the Pacific than in the
ic United States, notwithstanding the similarity of the
!

representation by allied species of genera peculiar, or
peculiar, to two regions, furnishes evidence of similar
and of equal pertinency with representation by identical
will hardly be doubted. Whether or not susceptible of
ic explanation, it is certain that related species of phænog-
plants are commonly associated in the same region, or
nd in comparatively approximate (however large) areas
lar climate.* Remarkable exceptions may indeed be ad-

fundamental and most difficult question remaining in natural history is here
l;—the question whether this actual geographical association of congeneric
nearly related species is primordial, and therefore beyond all scientific ex-
, or whether even this may be to a certain extent a natural result. The
worthy attempt at a scientific solution of the problem, aiming to bring the
s well as the geographical association of existing species more within the
f cause and effect, is that of Mr. Darwin and (later) of Mr. Wallace,—par-
tched in their short papers "On the Tendency of Species to form varieties,
e Perpetuation of Varieties and Species by natural Means of Selection," in
nal of the Proceedings of the Linnæan Society, vol. iii. (Zoölogy), p. 45.
s there suggested must bear a prominent part in future investigations into
bution and probable origin of species. It will hardly be doubted that the
s and causes indicated are really operative; the question is as to the extent
peration. But I am already disposed, on these and other grounds, to admit
t are termed closely related species may in many cases be lineal descend-

duced, but the fact that they are remarkable goes to confirm the proposition. Indeed, the general expectation of botanists in this regard sufficiently indicates the common, implicit opinion. The discovery of a new *Sarracenia* or a new *Halesia* in the Atlantic United States, or of a new *Eschscholtzia*, *Platystemon*, or *Calais* west of the Rocky Mountains, would excite no surprise. A converse discovery, or the detection of any of these genera in a remote region, would excite great surprise. The discovery of numerous closely related species thus divided between two widely separated districts might not, in the present state of our knowledge, suggest former continuity, migration, or interchange; but that of identical species peculiar to the two inevitably would.

Why should it? Evidently because the natural supposition is that individuals of the same kind are descendants from a common stock, or have spread from a common centre; and because the progress of investigation, instead of eliminating this preconception from the minds of botanists, has rather confirmed it. Every other hypothesis has derived its principal support from difficulties in the application of this. A review of what has been published upon the subject of late years makes it clear that the doctrine of the local origin of vegetable species has been more and more accepted, although, during the same period, species have been shown to be much more widely dispersed than was formerly supposed. Facts of the latter kind, and the conclusions to which they point, have been most largely and cogently brought out by Dr. Hooker, and are among the very important general results of his extensive investigations. And the best evidence of the preponderance of the theory of the local origin of species, notwithstanding the great increase of facts which at first would seem to tell the other way,—is furnished by the works of the present De Candolle upon geographical botany. This careful and conscientious investigator formerly adopted and strenuously maintained Schouw's hypothesis of the double or multiple origin of species. But in his great work, the *Géographie Botanique Raisonnée*, published in the year 1855, he has in effect discarded it, and this not from any theoretical objections to that view, but because he found it no longer needed to account for the general facts of distribution. This appears from his qualified, though dubious, adherence to the hypothesis of a double origin, as a *dernier ressort*, in the few and extraordinary cases which he could hardly explain in any other way. His decisive instance, indeed, is the occurrence of the Eastern American *Phryma leptostachya* in the Himalaya Mountains.

ants from a pristine stock, just as domesticated races are; or, in other words, that the limits of occasional variation in species (if by them we mean primordial forms) are wider than is generally supposed, and that derivative forms when segregated may be as constantly reproduced as their originals.

ıe facts presented in the present memoir effectually dispose ıis subsidiary hypothesis, by showing that the supposed e exception belongs to a not uncommon case. Indeed, so y species are now known to be common to Eastern and hern Asia and Eastern North America,—some of them occng also in Northwestern America and some not,—and so y genera are divided between these two regions, that the anlent improbability of such occurrence is done away, and ı cases of the kind may be confidently expected. However rs may regard them, it is clear that De Candolle would now ıin these cases in accordance with the general views of distion adopted by him, under which they naturally fall,—so doning the notion of a separate creation.

know not whether any botanist continues to maintain uw's hypothesis. But its elements have been developed into ferent and more comprehensive doctrine, that of Agassiz, h should now be contemplated. It may be denominated *ıutochthonal* hypothesis.

place of the ordinary conception, that each species originin a local area, whence it has been diffused, according to mstances, over more or less broad tracts,—in some cases ning widely discontinuous in area through climatic or other ical changes operating during a long period of time,—Pror Agassiz maintains, substantially, that each species originwhere it now occurs, probably in as great a number of iduals occupying as large an area, and generally the same or the same discontinuous areas, as at the present time.

ıis hypothesis is more difficult to test, because more ideal any other. It might suffice for the present purpose to re:, that, in referring the actual distribution, no less than the n, of existing species to the Divine will, it would remove rhole question out of the field of inductive science. Regards a *philosophical* question, Maupertuis's well known "prinof least action" might be legitimately urged against it; ely, "that it is inconsistent with our idea of Divine wisdom, the Creator should use more power than was necessary to nplish a given end." This philosophical principle holds so ly true in all the mechanical adaptations of the universe, as essor Peirce has shown, that we cannot think it inapplicable e organic world also, and especially to the creation of beings wed with such enormous multiplying power, and such ıs and facilities for dissemination, as most plants and ani. Why then should we suppose the Creator to do that suıturally which would be naturally effected by the very umentalities which he has set in operation?

ewed, however, simply in its *scientific* applications to the tion under consideration, (the distribution of plants in the

temperate zone of the northern hemisphere,) the autochthona hypothesis might be tested by inquiring whether the p rimitiv or earliest range of our species could possibly have remained unaffected by the serious and prolonged climatic vicissitudes to which they must needs have been subject; and whether these vicissitudes, and their natural consequences, may not suffice to explain the partial intermingling of the floras of North America and Northern Asia, upon the supposition of the local origin of each species. Let us bring to the inquiry the considerations which Mr. Darwin first brought to bear upon such questions, and which have been systematically developed and applied by the late Edward Forbes, by Dr. Hooker, and by Alphonse De Candolle.

No one now supposes that the existing species of plants are of recent creation, or that their present distribution is the result of a few thousand years. Various lines of evidence conspire to show that the time which has elapsed since the close of the tertiary period covers an immense number of years; and that our existing flora may in part date from the tertiary period itself. It is now generally admitted that about 20 per cent of the Mollusca of the middle tertiary (miocene epoch), and 40 per cent of the pliocene species on the Atlantic coast still exist; and it is altogether probable that as large a portion of the vegetation may be of equal antiquity. From the nature of the case, the direct evidence as respects the flora could not be expected to be equally abundant. Still, although the fossil plants of the tertiary and the post-tertiary of North America have only now begun to be studied, the needful evidence is not wanting.

On our northwestern coast, in the miocene of Vancouver's Island, among a singular mixture of species referable to *Salix*, *Populus*, *Quercus*, *Planera*, *Diospyros*, *Salisburia*, *Ficus*, *Cinnamomum*, *Personia*, or other *Proteaceæ*, and a Palm (the latter genera decisively indicating a tropical or subtropical climate), Mr. Lesquereux has identified one existing species, a true characteristic of the same region ten or fifteen degrees farther south, viz., the Redwood or *Sequoia sempervirens*. In beds at Somerville referred to the lower or middle pliocene by Mr. Lesquereux, this botanist has recently identified the leaves of *Persea Carolinensis*, *Prunus Caroliniana*, and *Quercus myrtifolia*, now inhabiting the warm sea-coast and islands of the Southern States.*

The pliocene quadrupeds of Nebraska also show that the climate east of the Rocky Mountains at this epoch was much warmer than now. About the Upper Missouri and Platte there were then several species of Camel (*Procamelus*) and allied Ruminantia and a Rhinoceros, besides a Mastodon, an Elephant, some Horses

* These and other data, obligingly communicated by Mr. Lesquereux, have been published in the May number of the American Journal of Science and Arts.

l their allies, not to mention a corresponding number of car-'orous animals. These herbivora probably fed in a good ;ree upon herbage and grasses of still existing species. For ·bs and grasses are generally capable of enduring much greater natic changes, and are therefore likely to be even more ancient n trees. These animals must have had at least a warm-tem-·ate climate to live in: so that in lat. 40°–43° they could not re been anywhere near the northern limit of the temperate ·a of those days; indeed the temperate flora, which now in ·stern Europe touches the Arctic Circle, must then have ched equally high latitude in Central, or Western North nerica. In other words, the temperate floras of America and ia must then have been conterminous (with small oceanic ·aration), and therefore have commingled, as conterminous ras of similar climate everywhere do.

At length, as the post-tertiary opened, the glacier epoch came wly on,—an extraordinary refrigeration of the northern hem-here, in the course of ages carrying glacial ice and arctic cli-te down nearly to the latitude of the Ohio. The change was dently so gradual that it did not destroy the temperate flora, least not those enumerated above as existing species. These l their fellows, or such as survive, must have been pushed on lower latitudes as the cold advanced, just as they now would if the temperature were to be again lowered; and between ·m and the ice there was doubtless a band of subarctic and ·tic vegetation,—portions of which, retreating up the moun-ns as the climate ameliorated and the ice receded, still scanti-survive upon our highest Alleghanies, and more abundantly on the colder summits of the mountains of New York and ·w England;—demonstrating the existence of the present arc-·alpine vegetation during the glacial era; and that the change climate at its close was so gradual that it was not destructive vegetable species.

As the temperature rose, and the ice gradually retreated, the rviving temperate flora must have returned northward *pari ssu,* and—which is an important point—must have advanced ıch farther northward, and especially northwestward, than it w does; so far, indeed, that the temperate floras of North nerica and of Eastern Asia, after having been for long ages ·st widely separated, must have become a second time conter-nous. Whatever doubts may be entertained respecting the istence of our present vegetation generally before the glacial ı, its existence immediately after that period will hardly be ·estioned. Here, therefore, may be adduced the direct evi-nce recently brought to light by Mr. Lesquereux, who has ·ntified our live oak (*Quercus virens*), Pecan (*Carya olivæfor-is*), Chinquapin (*Castanea pumila*), Planer-tree (*Planera Gme-*

lina), Honey-Locust (*Gleditschia triacanthos*), *Prinos coriaceus*, and *Acorus Calamus*,—besides an elm and a *Ceanothus* doubtfully referable to existing species,—on the Mississippi, near Columbus, Kentucky, in beds which Mr. Lesquereux regards as anterior to the drift. Professor D. D. Owen has indicated their position "as about 120 feet lower than the ferrugineous sand in which the bones of the *Megalonyx Jeffersonii* were found." So that they belong to the period immediately succeeding the drift, if not to that immediately preceeding it. All the vegetable remains of this deposit, which have been obtained in a determinable condition, have been referred, either positively or probably, to existing species of the United States flora, most of them now inhabiting the region a few degrees farther south.

If, then, our present temperate flora existed at the close of the glacial epoch, the evidence that it soon attained a high northern range is ready to our hand. For then followed the second epoch of the post-tertiary, called the *fluvial* by Dana, when the region of St. Lawrence and Lake Champlain was submerged, and the sea there stood five hundred feet above its present level; when the higher temperate latitudes of North America, and probably the arctic generally, were less elevated than now, and the rivers vastly larger, as shown by the immense upper alluvial plains, from fifty to three hundred feet above their present beds; and when the diminished breadth and lessened height of northern land must have given a much milder climate than the present.

Whatever the cause, the milder climate of the fluvial epoch is undoubted. Its character, and therefore that of the vegetation, is decisively shown, as geologists have remarked, by the quadrupeds. While the *Megatherium*, *Mylodon*, *Dicotyles*, &c. demonstrate a warmer climate than the present in the Southern and Middle United States, the *Elephas primigenius*, ranging from Canada to the very shores of the Arctic Ocean, equally proves a temperate climate and a temperate flora in these northern regions. This is still more apparent in the species of the other continent, where, in Siberia, not only the *Elephas primigenius*, but also a Rhinoceros, roamed northward to the arctic sea-coast. The quadrupeds that inhabited Europe in the same epoch are well known to indicate a warm-temperate climate as far north as Britain, in the middle, if not the later post-tertiary. North America then had its herds of Mastodons, Elephants, Buffaloes or Bisons of different species, Elks, Horses, *Megalonyx*, the Lion, &c.; and, from the relations between this fauna and that of Europe, there is little doubt that the climate was as much milder than the present on this as on the other side of the ocean. All the facts known to us in the tertiary and post-tertiary, even to the limiting line of the drift, conspire to show that the difference between the two continents as to temperature was very nearly the same then

ıow, and that the isothermal lines of the northern hemisphere ved in the directions they now do.

climate such as these facts demonstrate for the fluvial epoch ıld again commingle the temperate floras of the two conti- ts at Behring's Straits, and earlier—propably through more l than now—by way of the Aleutian and Kurile Islands. I not imagine a state of circumstances under which the Siberian phant could migrate, and temperate plants could not.

'he fluvial was succeeded by the "*terrace* epoch," as Dana ıes it, "a time of transition towards the present condition, ıging the northern part of the continent up to its present el, and down to its present cool temperature,"*—giving the ic flora its present range, and again separating the temperate as of the New and of the Old World to the extent they are r separated.

Jnder the light which these geological considerations throw n the question, I cannot resist the conclusion, that the extant etable kingdom has a long and eventful history, and that the lanation of apparent anomalies in the geological distribution pecies may be found in the various and prolonged climatic or er physical vicissitudes to which they have been subject in lier times;—that the occurrence of certain species, formerly posed to be peculiar to North America, in a remote or anti- al region affords of itself no presumption that they were orig- ted there;—and that the interchange of plants between Eastern rth America and Eastern Asia is explicable upon the most ural and generally received hypothesis, (or at least offers no ater difficulty than does the Arctic flora, the general homo- eousness of which round the world has always been thought ıpatible with local origin of the species,) and is perhaps not re extensive than might be expected under the circumstances. at the interchange has mainly taken place in high northern tudes, and that the isothermal lines have in earlier times ned northward on our eastern, and southward on our north- st coast, as they now do, are points which go far towards ex- ining why Eastern North America, rather than Oregon and ifornia, has been mainly concerned in it, and why the tem- ate interchange, even with Europe, has principally taken ce through Asia.

Brasenia peltata.—To the remarks upon the known range of his species, I have now to add the interesting fact, that it exists n the northwestern coast of America, having been gathered Dr. Pickering, in Wilkes's South Sea Exploring Expedition, a stream which falls into Gray's Harbor, lat. 47°. It must be

For the collocation and communication of the geological data here presented, I indebted to the kindness of my friend, Professor Dana.

local on the western side of the continent, or it would have been met with before. When this remarkable plant was known to occur only in Eastern North America and Eastern Australia, it made the strongest case in favor of double creation that perhaps has ever been adduced. But since it has been found to occur throughout the Eastern Himalayas and in Japan, and has now been detected in Northwestern America also, the case seems to crown the conclusions to which this memoir arrives.

ART. XXI.—*Supplement to an Enumeration of North American Lichens, continued;* by EDWARD TUCKERMAN, A.M., Professor of Botany in Amherst College.

THE species follow each other, as before, in the order of the arrangement proposed by Dr. Nylander, who has studied these plants in the light afforded by a knowledge which includes not only the external, but all the microscopical details. Some species, not North American as yet known, but of more or less interest in connection with our flora, are added in brackets.

COLLEMA APALACHENSE, Tuck. in litt., thallo stellato multifido imbricato crassiusculo fusco-viridi, laciniis plano-convexis apice subteretibus obtusis rugulosis, subtus pallidis; apotheciis innato-sessilibus planis rufescentibus margine integerrimo. Sporæ ellipsoideæ 3-septatæ diam. vix duplo longiores. Lime-rocks, Hancock county, Alabama, *Hon. T. M. Peters.*

COLLEMA TEXANUM, sp. nova, thallo orbiculari substellato imbricato crasso luteo-virescente, laciniis radiantibus elongatis subplanis profunde pinnato-laceris papulosis; apotheciis sparsis planiusculis rufis margine tumido integro. Sporæ minimæ fusiformes uniseptatæ.—Trees, Texas, *Mr. Charles Wright.* Resembles the more perfect forms of C. pulposum. Spores exceedingly small. I am indebted, for their detection and delineation, to my friend, the Rev. J. L. Russell.

LEPTOGIUM CRENATELLUM, sp. nova, thallo imbricato tenerrimo glauco-cinerascente, laciniis rotundatis crenatis denticulatis; apotheciis minusculis creberrimis sessilibus convexis pallido-fuscescentibus margine tenui pallescente subintegro evanescente. Sporæ ellipsoideæ 5-septatæ.—On trees in swamps, Brattleborough, Vermont, *Mr. C. C. Frost.*

LEPTOGIUM JUNIPERINUM, Tuck. in litt., thallo pusillo suborbiculari imbricato tenui plumbeo e lobis rotundatis adscendentibus crenatis subtus ad margines albo-fibrillosis; apotheciis sessilibus plano-convexis margine tenui demum evanido discum rufo-fuscum cingente. Sporæ ellipsoideæ apicibus acutæ 3-septatæ.—On the earth in cedar woods, Texas. *Mr. Wright.*

CIUM CURTISII, sp. nova, thallo byssaceo nigro (vel obso- ›otheciis minutis turbinatis disco subnitido nigro stipiti- ›vibus ex albido rufescentibus demum nigris. Sporæ ma- › ellipsoideæ vel elongato-ellipsoideæ (dactylinæ, *Koerb.*) entes simplices.—On the living bark of Rhus typhina, in ire, Massachusetts; and of Robinia Pseudacacia, at the ›rings, Virginia, *Rev. Dr. Curtis.* The stipes like those of m or Coniocybe nigricans, Fr. (not of Tuckerm. Synops. [. E. which is C. subtile, on Bark) but the apothecia quite it, and the spores very much larger than in that species; C. eusporum, Nyl., to which, and C. byssaceum, Fr., the is probably nearest.

MYCES ABSOLUTUS, sp. nova, thallo crustaceo effuso te- ıo submembranaceo læteviridi; apotheciis stipitatis incar- ılanis disco demum convexiusculo marginem tenuem ex- ‹e. Sporæ ellipsoideæ simplices hyalinæ. Biatora icma- ı, var. stipitata, Tuckerm. in litt. ad cel. Montagne.—On th, Alabama, *Mr. Peters.* [Mountains of Cuba, *Mr. Wright.* ıela, *Mr. Fendler.*] Representing possibly, in tropical ›a, both B. ericetorum (B. roseus, Auctt.) and B. æerugino- at. icmadophila, Auctt.) but nearest to the last, which it ›o connect, naturally, with the first.

DONIA DACTYLOTA, sp. nova, thalli squamulis amplis subtus albo-pulverulentis podetia gracilescentia cylindrica anaceo-corticata lævigata viridi-pallescentia e margine pro- ›us, scyphis angustatis margine subincurvis denticulatis ı oblique prolifero-palmatis; apotheciis carneo-fuscescen-

β, symphycarpia, podetiis elongatis scyphis subintegris soletis) apotheciis conglomeratis.

γ, sorediata, podetiis hinc inde, scyphisque, vel his oblite- ›icibus clavatis cornutisve sorediis pulvinatis albis adsper- n the earth in the mountains of Cuba, *Mr. Wright.* Ven- *Mr. Fendler.* Differs from C. fimbriata as C. digitata from C. deformis. The primary form is hardly distin- ›le from C. digitata, except in being whiter, and in the f the apothecia. The white, cushion-like, powdery sore- ıich, in what seems to be the commonest state, take the f the apothecia, and are scattered over the smooth podetia latter case appearing clearly to be deliquescent squamules) perhaps the most striking, however an abnormal feature elegant Cladonia.]

ROCAULON NANODES, sp. nova, podetiis pumilis erectis so-conglomeratis subnudis validis tereti-compressis a basi picemque versus fastigiato-ramosis albidis, phyllocladiis ›es confertis e rotundato-subsquamaceis glaucis demum

pulverulentis; apotheciis terminalibus dilatatis demum convexis. Sporæ generis. S. nanum, Tuck. Synops. N. E. p. 46, pr. p.—Rocks near water, (Crystal Falls; Saco Falls; Upper Gorge of the Ammonoosuck) in the White Mountains. S. nanum of European authors (Fr. Lich. Suec. n. 59; Schær. Lich. Helv. n. 588; Moug. and Nestl. Crypt. Vog. n. 647) appears to be an atypical condition, and has not yet occurred with us, but I have hitherto taken the present as representing the perfect state of the species. The full development of our lichen seems however to indicate a different affinity, and to separate it from the section (Chondrocaulon, Th. Fr.) which includes S. nanum. It is perhaps rather nearer to S. denudatum.

STEREOCAULON CHLORELLUM, sp. nova, podetiis pumilis erectis glabris nitidis subcompressis lacunosis stramineis fastigiato-ramosis, phyllocladiis ad apices confertis minutis rotundatis mox deliquescentibus pulverulentis; apotheciis . . . . .—Rocks, Islands of Behring's Straits, *Mr. Wright.* At once distinguishable by its minuteness, smoothness, and pale-yellow or straw color. The granules (phyllocladia, Th. Fr.) are exceedingly small. The apothecia are as yet unknown.

STEREOCAULON? WRIGHTII, sp. nova, thallo cæspitoso cartilagineo subfoliaceo glaucescente, ramis laciniæformibus adscentibus extrorsum latioribus inciso-ramosis crenatis margine inflexis crispatis supra viridescentibus subtus nervosis tenuiter tomentosis; cephalodiis majusculis pulvinatis viridi-nigrescentibus plicato-rugosis demum floccosis; apotheciis . . . . —Rocks, Islands of Behring's Straits, *Mr. Wright.* With the habit of erect states of Squamaria chrysoleuca, but the cephalodia of Stereocaulon. It is perhaps not impossible that these little understood developments should occur outside of the present genus, or that this lichen should be *sui generis.* The crisped margins take often the shape of Parmeliaceous apothecia, thus increasing the general resemblance of the plant to a Squamaria. But it has also evident points of similarity to Stereocaulon? pulvinatum, Ach., an obscure Cape of Good Hope lichen, for specimens of which I am indebted to Dr. Sonder of Hamburg. The apothecia of this last also are unknown.

[ALECTORIA JAPONICA, sp. nova, thallo subcæspitoso tereti rigido sorediis albis exasperato stramineo, ramis sterilibus ramosissimis implexis attenuatis subfilamentosis, fertilibus simpliciusculis incrassatis, apicibus nigricantibus; apotheciis subterminalibus superficiali-sessilibus appendiculatis disco concavo demum expanso plano nitido castaneo. Sporæ majusculæ ellipsoideæ limbatæ viridi-fuscescentes demum subhyalinæ.—On dead pine trees, Ayan, Japan, *Mr. Wright.* Nearest to A. ochroleuca, but differing very much in habit, and in fructification. The spores are not very unlike those of Pertusaria pertusa.]

ɪALINA DASYPOGA, sp. nova, thallo filamentoso rigidius-ıgili tereti lævigato viridi-fuscescente (pallescente) ramis ;is dichotome ramosis ultimis acuminatis nodulosis; apo-concavis demum planis repandis margine tenui incurvo ıulato disparente. Sporæ ellipsoideæ uniseptatæ curvulæ e diam. duplo longiores.—On trees and rocks in the ɩins of Cuba, *Mr. Wright.* Allied to R. usneoides (Ach.) 'hich has also been found in Cuba, by the same unwearied ›r, but differs in its regularly terete thallus, larger apothe- It is still more like a pendulous Usnea, or perhaps ria; but possesses the spores of the present genus.]

ɩARIA CALIFORNICA, sp. nova, thallo cæspitoso cartilagineo ɜo lacunoso-subcanaliculato opaco e viridi fuscescente, ra-ɜgulariter subdichotome ramosis patentibus, fertilibus su-ncrassatis; apotheciis terminalibus appendiculatis margine ⊦fimbriatis demum convexis nigris.—On the bark of trees, ey, California, *Menzies.* Fronds in small, roundish masses, branches diverging from a single base, with the aspect of a small, slender state of Ramalina calicaris, β, than of ct Cetrariæ, to which, and in particular C. tristis and C. a, it is indeed, if I mistake not, nearest allied. The sta-pon trees, and on the coast of California, is a very un-one for C. aculeata, from which the present also differs :ably in habit of growth, and in color. Though more ɩventy years have passed since the venerable botanist who ɩe these specimens collected them, they appear to be un-ed.

ΓA RAVENELII, sp. nova, thallo pusillo suborbiculari mem-ɜo appresso scrobiculato viridi-glaucescente (fuscescente) elongatis sinuato-lobatis crenatis (glomerulis fruticulosis us nunc aspersis) subtus fuscescentibus tomentosis; apo-sparsis margine inflexo persistente crenulato-sublobato. elongato-fusiformes 1–3-septatæ virescentes diam. 12–20-giores.—Trees, in the low country of South Carolina, *Mr. l;* Alabama, on trees, *Mr. Peters;* and also on rocks (the en dark brown), *Mr. Beaumont;* Mississippi, *Dr. Veitch;* ɩna, *Dr. Hale;* (Cuba, *Mr. Wright.*)—A smaller plant than of the two species of this group, of the northern hemi-with much the lobation of S. glomerulifera, but the tex-' S. herbacea, and distinguished, so far as my specimens m both, by its strongly pitted upper surface, and its cren-›bate apothecia, which rather approach those of some of ›pical members of the group, as S. pallida, Hook. The 'ules appear only on a Cuban specimen. They are quite ɩose of S. glomerulifera, but the largest do not exceed a diameter. The spores are more elongated than those of ɜcies just mentioned, and appear to be differently septate.

[STICTA WRIGHTII, sp. nova, thallo subcoriaceo adpresso lævigato viridi-glaucescente, laciniis rotundatis sinuato-incisis crenatis subtus fuscis ambitu pallescentibus tomentosis, cyphellis plano-concavis albis; apotheciis sparsis elevatis extus mammillatis e concavo margine inflexo demum planis margine irregulari subevanescente. Sporæ late fusiformes uniseptatæ limbatæ virescentes diam. c. 5-plo longiores.—On beech trunks, mountain sides, Hakodadi, Japan, *Mr. Wright.* With the apothecia, and the general aspect of S. glomerulifera, but differing in a rather more loose habit of lobation, it which it approaches nearer to the broader forms of S. damæcornis; in its spores; and most remarkably, in possessing in abundance, regular cyphellæ; which resemble those of S. fuliginosa, though also occurring urceolate, as in S. damæcornis. The genus Ricasolia, De Not., was originally constituted, to include the natural group of species to which the present belongs, on a mistaken comparison of the apothecia of these species, with certain abnormal apothecia common in other species of Sticta, which are now regarded, since the publication of Mr. Tulasne's important researches, as morbid conditions, infested by a parasitic cryptogam. (Tulasne, Mém. sur les Lichens, p. 123, note.) The species included in the group, agreeing as they do in many obvious features, were also once supposed to be destitute of cyphellæ, and the greater part, and in particular, the tropical ones, probably are so; but Fries and Delise testify to the occurrence of this development, however rarely, in both the old species of the northern hemisphere, while in the Japanese lichen, above-described, it is normal. This species may not improbably be found to occur also in North America.]

[PHYSCIA? WRIGHTII, sp. nova, thallo orbiculari imbricato tenui molliusculo polito pallide viridi (glaucescente) subtus albo venis minusculis prominulis villosis reticulato, hypothallo nunc crassiusculo byssaceo-lanuginoso cinerascente, laciniis planis irregulariter multifido-lacinulatis, ambitu latioribus palmatis, centro plus minus excrescentiis isidiomorphis cylindricis obsitis; apotheciis subcentralibus sessilibus disco plano luteolo margine crasso incurvo crenulato cincto demum flexuosis. Sporæ.... —On trunks of trees in dense woods, in the mountains of Cuba, *Mr. Wright.* With the habit of Physcia, but also a good deal resembling Parmelia ambigua. The species appears to be undescribed.]

LECANORA ASCOCISCANA, Tuck. herb. Psoroma, Tuckerm. suppl. &c. in Amer. Journ. Sci., xxv, p. 424. There is something in this curious lichen which suggests a near affinity to Psoroma, as the genus is constituted by Dr. Nylander, but the fuscescent, often a little curved and kidney-shaped, one-septate

s indicate its true place in Lecanora, where it long stood in erbarium. The spores resemble those (I owe the suggestion . Nylander) of L. sophodes, but the lichen is very distinct.

ECANORA CAMPALEA, sp. nova, thallo crustaceo tartareo coso-subplicato lævigato viridi-glaucescente (pallescente) thallo nigro insigni limitato; apotheciis appressis demum oso-irregularibus disco tumente e rufo fusco-nigrescente mar-thallode integro pallente. Sporæ suboctonæ elongato-fusi-s 5-pluriseptatæ diam. 10–15 plo longiores hyalinæ.—Trees, 1 of Cuba, *Mr. Wright.* The affinity of this elegant lichen ventosa is indicated, no less by the spores than by the ex-l characters.]

IATORA RHODOPIS, sp. nova, thallo crustaceo effuso tenui agineo-membranaceo lævigato rimuloso limitato glauco-cin-ente, intus miniato; apotheciis sessilibus hinc inde aggrega-mum difformibus margine tumidulo integerrimo lævi mox oso saturate roseo discum subplanum nudum rufo-nigrescen-hypothecio crassiusculo nigro impositum cingente. Sporæ tonæ ellipsoideæ simplices diam. duplo longiores hyalinæ. bushes in the Island of Cuba, *Mr. Wright.* Differs re-ably from described species, but has somewhat of the gen-spect of L. domingensis.

ITORA VIRELLA, sp. nova, thallo crustaceo effuso incrustante rtareo rugoso-granulato glauco-sulphureo, humecto viridi; eciis sessilibus margine tenui pallidiori integerrimo mox oso evanido discum planoconvexum rufo-fuscescentem cin-. Sporæ minusculæ ellipsoideæ subfusiformes diam. triplo ores hyalinæ.—On rocks in dense woods, in the mountains iba, *Mr. Wright.* With the habit of L. glebulosa.

ITORA PYRRHOMELÆNA, sp. nova, thallo e granulis minutis datis mox subsquamaceis imbricatis glaucescentibus intus tis hypothallum crassum rufo-nigricantem ad ambitum inentem interrupte obtegentibus; apotheciis ex hypothallo dis subplanis margine tenuissimo erecto flexuoso rufo-ni-ente discum nigrum nitidum hypothecio rufo impositum nte, dein conglomeratis convexis marginem excludentibus. e minutæ ellipsoideæ simplices hyalinæ.—On trunks of near the ground, in the mountains of Cuba, *Mr. Wright.* to B. parvifolia, but differing as described.

ITORA PHÆASPIS, sp. nova, thallo crustaceo effuso e granulis uamaceis mox corallinis pallide ochroleucis; apotheciis ap-s rufo-fuscis flexuosis disco demum convexo marginem ob-i pallidiorem excludente. Sporæ fusiformi-cylindricæ 1–4-æ diam. 3–4-plo longiores hyalinæ.—Trees, Cuba, *Mr.* *ht.* Also resembling B. parvifolia in general appearance,

but the spores connect the lichen rather with B. vernalis. It does not appear to be described.]

GYROSTOMUM CURTISII, Tuckerm. suppl. in Amer. Journ. Sci., xxv, p. 430, a determination made upon high authority, is referred by my friend Mr. Russell to Lecidea; and the spores, as his sketch fully shows, indicate that the lichen is probably only a small form of L. disciformis (L. parasema, Fr. *a*) in which the apothecia are a little urceolate. G. urceolatum is also referred to Lecidea by Dr. Nylander (Enum. Gen., p. 127) but seems to me to be remarkably distinguished by the structure of the apothecium, and the vermicular spores.

ART. XXII.—*On the Phenomena of Gemmation.—Lecture before the meeting of the Royal Institution of Great Britain, by* THOMAS H. HUXLEY, F.R.S.*

THE speaker commenced by stating that a learned French naturalist, M. Duvau, proposed many years ago, to term the middle of the eighteenth century, "l'Époque des Pucerons:" and that the importance of the phenomena which first brought to light by the study of these remarkable insects renders the phrase "Epoch of Plant-lice," as applied to this period, far less whimsically inappropriate than it might at first sight seem to be.

After a brief sketch of the mode of life of these Plant-lice, or *Aphides*, as they are technically termed; of the structure of their singular piercing and sucking mouths; and of their relations to what are called "Blights;" the circumstances which have more particularly drawn the attention of naturalists to these insects were fully detailed.

It was between the years 1740 and 1750, in fact, that Bonnet, acting upon the suggestions of the illustrious Reaumur, isolated an *Aphis* immediately after its birth, and proved to demonstration, that not only was it capable of spontaneously bringing forth numerous living young, but that these and their descendants, to the ninth generation, preserved a similar faculty.

Observations so remarkable were not likely to pass unheeded; but notwithstauding the careful sifting which they have received, Bonnet's results have never been questioned. On the contrary, not only have Lyonet, Degeer, Kyber, Duvau, and others, borne ample testimony to their accuracy, but it has been shown that, under favorable conditions of temperature and food, there is practically no limit to this power of a sexual multiplication, or as it has been conveniently termed, "Agamogenesis."

* From the Proceedings of the Royal Institution of Great Britain, May, 1858,

ιus Kyber bred the viviparous *Aphis Dianthi* and *Aphis* : for three years in interrupted succession; and the males rue oviparous females of the *A. dianthi* have never yet been with. The current notion that there is a fixed number of ds, "nine or eleven," is based on a mistake.

ι, under moderately favorable conditions, an *Aphis* comes to ιrity in about a fortnight; and as each *Aphis* is known to be ble of producing a hundred young, the number of the prog- which may eventually result from a single *Aphis* during the r seven warm months of the year is easily calculated. M. ;ard's estimate adopted, (and acknowledged) by Morren, and d from him by others, gives the number of the tenth brood ιe quintillion. Supposing the weight of each *Aphis* to be no than $\frac{1}{1000}$th of a grain, the mass of living matter in this l would exceed that in the most thickly populated countries e world.

ιe agamogenetic broods are either winged or wingless. The ed forms at times rise into the air, and are carried away by rind in clouds; and these migrating hordes have been sup- l to be males and females, swarming like the ants and bees! ng the summer months it is unusual to meet other than arous *Aphides*, whether winged or wingless; but ordinarily, ιe approach of cold weather, or even during warm weather, supplies of food fall short, the viviparous *Aphides* produce s which are no longer viviparous, but are males and arous females. The former are sometimes winged, some- s wingless. The latter, with a single doubtful exception, lways wingless.

ιe oviparous females lay their eggs, and then, like the s, die. It commonly happens also that the viviparous *ides* die, and then the eggs are left as the sole representatives ιe species; but in mild winters many of the viviparous *ides* merely fall into a state of stupor and hybernate, to rake with the returning warmth of spring. At the same the eggs are hatched and give rise to viviparous *Aphides*, h run through the same course as before. The species is, therefore, is fully manifested not in any one being or ιated form, but by a cycle of such, consisting of,—1st. the 2nd, An indefinite succession of viviparous *Aphides;* 3rd, s and females eventually prodeced by these, and giving rise ιe egg again.

, armed with the microscope and scalpel, we examine into minute nature of these processes (without which inquiry all ulation upon their nature is in vain), we find that the vivip- s *Aphis* contains an organ similar to the ovarium of the arous female, in some respects, but differing from it, as Von old was the first to show, in the absence of what are termed

the colleterial glands and the spermatheca—organs of essential importance to the oviparous form.

In the terminal chambers of this "Pseud-ovarium," ovum-like bodies, thence called "pseud-ova," are found. These bodies pass one by one into the pseudovarian tubes, and there gradually become developed into young, living *Aphides*. As Morren has well said, therefore, the young *Aphides* are produced by "the individualization of a previously organized tissue."

The only organic operation with which this mode of development can be compared, is the process of budding or gemmation as it takes place in the vegetable kingdom, in the lower forms of animal life, and in the process of formation of the limbs and other organs of the higher animals. And the parallel is complete if such a plant as the bulbiferous lily or the *Marchantia*, or such an animal as the *Hydra*, is made the term of comparison.

Thus agamogenesis in *Aphis*, is a kind of internal budding or gemmation. If we inquire how this process differs from multiplication by true ova or "Gamogenesis," we find that the young ovum in the ovarium is also, to all intents and purposes, a bud, indistinguishable from the germ in the pseudovarium of the agamogenetic *Aphis*. Histologically there is no difference between the two; but there is an immense qualitative or physiological difference, which cannot be detected by the eye, but becomes at once obvious in the behavior of the two germs after a certain period of their growth. Dating from this period, the pseudovum spontaneously passes into the form of an embryo, becoming larger and larger as it does so; but the ovum simply enlarges, accumulates nutritive matter, acquires its outer investments, and then falls into a state of apparent rest, from which it will never emerge, unless the influence of the spermatozoon have been brought to bear upon it.

That the vast physiological difference between the ovum and the pseudovum should reveal itself in the young state by no external sign, is no more wonderful than that primarily the tissue of the brain should be undistinguishable from that of the heart.

The phenomena which have been described, were long supposed to be isolated, but numerous cases of a like kind, some even more remarkable, are now known.

Among the latter, the speaker cited the wonderful circumstances attending the production of the drones among bees, as described by Von Siebold; and he drew attention to the plant upon the table, *Cœlobogyne ilicifolia*, a female euphorbiaceous shrub, the male flowers of which have never yet been seen, and which nevertheless, for the last twenty years, has produced its annual crop of fertile seeds in Kew Gardens.

Not only can we find numerous cases of agamogenesis similar to that exhibited by *Aphis* in the animal and vegetable worlds,

but if we look closely into the matter, agamogenesis is found to pass by insensible gradations into the commonest phenomena of life. All life, in fact, is accompanied by incessant growth and metamorphosis; and every animal and plant above the very lowest attains its adult form by the development of a succession of buds. When these buds remain connected together, we do not distinguish the process as anything remarkable; when on the other hand, they become detached and live independently, we have agamogenesis. Why some buds assume one form and some another, why some remain attached and some become detached, we know not. Such phenomena are for the present the ultimate facts of biological science; and we cannot understand the simplest among them, it would seem useless, as yet, to seek for an explanation of the more complex.

Nevertheless, an explanation of agamogenesis in the *Aphis* and in like cases has been offered. It has been supposed to depend upon "the retention unchanged of some part of the primitive germ-mass;" this germ-mass being imagined to be the seat of a peculiar force, by virtue of which it gives rise to independent organisms.

There are however two objections to this hypothesis: in the first place, it is at direct variance with the results of observation; in the second, even if it were true, it does not help us to understand the phenomena. With regard to the former point, the hypothesis professes to be based upon only two direct observations, one upon *Aphis*, the other upon *Hydra;* and both these observations are erroneous, for in neither of these animals is any portion of the primitive germ-mass retained, as is said to be, in that part which is the seat of agamogenesis.

But suppose the fact to be as the hypothesis requires; imagine that the terminal chamber of the pseudovarium is full of nothing but "unaltered germ-cells;" how does this explain the phenomena? Structures having quite as great a claim to the title of "unaltered germ-cells" lie in the extremities of the acini of the secreting glands, in the sub-epidermal tissues and elsewhere; why do not they give rise to young? Cells, less changed than those of the pseudovarium of *Aphis*, and more directly derived from the primitive germ-mass, underlie the epidermis of one's hand; nevertheless, no one feels any alarm lest a nascent wart should turn out to be an heir.

On the whole, it would seem better, when one is ignorant, to say so, and not to retard the progress of sound inquiry by inventing hypotheses involving the assumption of structures which have no existence, and of "forces" which, their laws being undetermined, are merely verbal entities.

ART. XXIII.—*On Earthquakes in Southern Italy, by* JAMES PHILIP LACAITA, Esq., LL.D.*

SOUTHERN Italy is celebrated for its delightful climate, its matchless scenery, its great historical associations; but it has also a less enviable renown; it is the classic ground of volcanoes and earthquakes. Etna and Vesuvius are the two most active volcanoes in Europe, and terrific earthquakes have often desolated vast districts of the country.

Though the common origin, to a certain extent, of the agents producing the phenomena of volcanoes and earthquakes is now scarcely questioned, considerable difference of opinion still prevails with regard to the real nature and character of those agents. It is for men of science to determine whether those agents are to be found in the internal heat of the earth which is supposed to arise from a state of fusion; or in the heat produced by chemical combinations and changes; or in the currents of electricity circulating on the earth's crust; or in any other causes whatsoever. On this *vexata quæstio* much light will no doubt be thrown before long by the observations made on the spot by Mr. Mallet, the distinguished author of the "Dynamics of Earthquakes," who, on the first news of the late earthquake in Southern Italy in December last, was sent thither by the Royal Society, for the pursuit of scientific enquiry. Without entering, however, into the field of science, the object of the speaker was to give the members of the Royal Institution a short account of six great earthquakes, without counting minor ones, which within the memory of man laid waste extensive tracts of the kingdom of Naples and caused great loss of life; and especially of the last earthquake, which took place on the night of the 16th of December, 1857.

1. On the 5th of February, 1783, at 1 P. M., the Piana di Monteleone, in the province of Calabria Ultra I, was convulsed by a violent shock of earthquake, which in less than two minutes levelled to the ground 109 towns and villages, and buried 32,000 out of 166,000 inhabitants under the ruins of their houses. A repetition of the shock at midnight ruined the towns of Reggio and Messina, and convulsed the whole Valdemone. At the entrance of the Faro Straits, the sea, retiring from the Calabrian shore and afterwards rushing back with overwhelming violence, swept away more than 1500 inhabitants of the town of Scylla, who had taken refuge on the beach for safety. After a succession of slight shocks, on the 28th of the following March, another violent shock convulsed the whole country from Reggio to Cape Colonna, an area of 1200 square miles, and added two

* From the Proceedings of the Royal Institution of Great Britain, May, 1858.

thousand more to the number of victims. Mountains were cleft asunder, high cliffs tumbled down, rivers turned from their bed or dammed in their course, lakes formed, valleys lifted up into hills, deep chasms opened, the physical aspect of the country changed, all distinctions of property altered. For twenty days a thick pestilential fog set over the desolated country; epidemic fevers followed in summer; and at the beginning of 1784 Calabria had already lost more than 80,000 inhabitants. From February to December 1783, there were no less than 949 shocks, and 151 in 1784; they did not altogether cease till 1786.

2. The mountain of Frosolone, in the province of Molise, the ancient *Samnium*, on the 26th of July, 1804, at 10½ P. M., was the centre of a violent shock of earthquake, which lasted 35 seconds, and caused great desolation over an area of 600 square miles. It ruined 61 towns and villages, and crushed to death more than 6000 people. It was severely felt as far as Naples, where all the buildings were greatly injured by its effects.

3. On the 29th of April, 1835, and on several successive days, the Val di Crati, in the province of Calabria Citra, including the town of Cosenza and its numerous villages, was convulsed by violent shocks of earthquake, which caused the death of more than 1000 people under the ruins.

4. On the 12th of October, 1836, the districts of Rossano and Castrovillari, in the same province, and the district of Lagonegro, in Basilicata, felt another violent shock of earthquake, which swept away more than 600 inhabitants.

5. The city of Melfi, built on a spur of Mount Vulture, an extinct volcano in the province of Basilicata, on the 14th of August, 1851, was the focus of a violent earthquake, which, besides Melfi itself, ruined Barile, Rapolla, and many other towns, and was felt as far as Naples on the western, and Brindisi on the eastern coast. The first shock, at 2 P. M., lasted 20 seconds; the second shock, at 3 P. M., lasted only five seconds. The loss of human life exceeded 1400; Melfi alone, out of 9274, lost 1093 inhabitants.

6. But worse than any of the latter earthquakes, and second only to the Calabrian one of 1783, was the earthquake which took place on the 16th of December last, at 10¼ P. M., at a season of the year, which, by a comparison of all the known dates of earthquakes, has been ascertained to be more subject to disturbances than any other. The sky was clear, the air still; indeed unusual stillness had prevailed the whole of that day. A sharp undulatory shock of 20 seconds' duration, immediately preceded and accompanied by an appalling hollow rumbling noise, had scarcely awaked the inhabitants, who, according to the early habits of provincial life had already retired to rest, when after a hardly perceptible pause of about three minutes, a second and

most violent successive and whirling shock of 25 seconds' duration crushed thousands of them under the ruins of their falling houses. Three other shocks were felt on that awful night, and many others on the following days; but none nearly so violent and so destructive as the two former ones. For nearly two months a slight shock was felt almost periodically just before sunrise. On the 7th of March, about 3 P. M., a violent shock, second only to those of the 16th of December, was felt, which caused considerable injury; and, according to the latest accounts, up to the 28th of April last, the shocks, though comparatively slight and harmless, still continued, and the people were in a state of constant alarm. Such was also the case in every one of the five previous earthquakes that have been noticed; the violence of the hidden agents at work was not at once exhausted by the first great shocks, but continued slightly to shake the ground for months, and sometimes, as in the Calabrian earthquake of 1783, for nearly four years afterwards.

The seat of this earthquake was in the central group of mountains in the provinces of Basilicata and Principato Citra, part of the main chain of the Apennines, which are the watershed between the streams flowing into the Tyrrhenian, the Ionian, and the Adriatic sea, and form the upper basins of the Calore or Tanagro, the Sele, the Ofanto, the Bradano, the Basento, the Sinno, and the Agri rivers. The centre of action, as far as it can be judged from the intensity of its terrific effects, was almost in the heart of the province of Basilicata, in a group of compact limestone mountains of the cretaceous period, the southern branch of the said central group, which running from north to south between the heads of the valleys of the Sinno and the Agri on the east, and the valley of Diano on the west, swells farther south into the lofty peaks of Monte Cocuzzo, Monte del Papa, and Monte Pollino, on the frontiers of Calabria. On the declivities or lower peaks of this group, which are covered with beds of tertiary marine marl sands and conglomerate, and within a district extending over an area of about 216 square miles, stand, or rather stood, the towns and villages of Montemurro, Saponara, Viggiano, Tramutola, Marsico Vetere, Marsico Nuovo, Spinosa and Sarconi, with an aggregate population of 35,570. Out of this number more than 12,000, or more than one-third, in less than half a minute were crushed to death; two thousand severely wounded! The ground was cracked and convulsed in the strangest manner; chasms and deep fissures were opened in several places, fertile hills became bare rocks, valleys were raised up, small pools formed, mountains cleft by deep ravines. The towns of Montemurro and Saponara especially were nearly entirely swept away; the former lost 5600 out of 7000, and the latter 3000 out of 4000 inhabitants. Saponara, which rose in

e middle ages out of the ancient *Grumentum*, where Hannibal stained a slight defeat by the Consul Claudius Nero, was most entirely levelled with the ground; there remain only a w shattered houses standing. Of Montemurro, originally a iraccnic settlement of the tenth century, literally nothing was ft but a heap of rubbish. On the morning of the 17th of ecember, 5600 of its inhabitants were dead or dying under the iins, 685 disabled by wounds; the few remaining unhurt found emselves torn from their dearest ones, houseless, amidst a mass ruins, without means of subsistence or help, and exposed to l the inclemency of a severe winter on a high peak of the pennines! A few days later the stench of the dead human ings under the ruins made life unbearable to the few surviving ies! Both at Montemurro and Saponara, most of the houses anding on beds of conglomerate had been overturned, or shufd in the strangest manner, and the ruins deposited in the vines beneath; the contents of the lower stories were, in seval instances thrown up into the stories above, or scattered to different directions, as if propelled by a central force. The enes of misery and horror that took place in those doomed wns exceed what imagination can fancy. Viggiano came next, town whose inhabitants from time immemorial have been in e habit of wandering, with their harps over different parts of e world, and return home with their savings in summer. It st 1700 out of 6634 inhabitants, and had most of the houses id churches overthrown. At this place an extensive fire added the horrors of the night.

From the centre of a triangle formed by these three towns, on hich the fury of the convulsion was more violently wreaked, e distances, in a direct line, are,—to the Gulf of Policastro, 24 iles; to Pæstum, on the Gulf of Salerno, 58 miles; to the outh of the Agri, on the Gulf of Tarentum, 47 miles; to the ctinct volcano of Mount Vulture, 55 miles; to Mount Vesuvius, l miles; to Bari, on the Adriatic, 80 miles; and to Mount tna, 195 miles.

Beyond this district, the terrific effects of the earthquake exnded, though somewhat diminished in intensity, over an area f more than 3000 square miles, destroying or injuring, more or ss, about 200 towns and villages, with an aggregate population f more than 200,000 inhabitants, of whom no less than 10,000 ere killed.

Within this area the beautiful and fertile valley of Diano, irough which flows the Tanagro, a tributary of the Sele, travsed in its length by the high road leading into Calabria, and alivened on both sides by numerous towns and villages built n the top or the slope of the hills, was sadly desolated. Polla said to have lost 2000 out of 7060 inhabitants; Padula, 500

out of 9000; Pertosa, 218 out of 1100; Sassano, 185 out of 3600; Montesano, 420 out of 4800, &c. Leaving the valley of Diano, and proceeding northwards to the head of the vallley of the Sele, will be found Brienza, Calvello, St. Angelo Le Fratte, Picerno, Tito, Potenza, the capital of Basilicata, etc., with most of their houses and public buildings ruined, and many of their inhabitants killed. At Tito, in particular, more than 300 out of 4939 inhabitants were crushed to death, and its beautiful Norman cathedral totally thrown to the ground. South of Potenza, in the upper valleys of the Bradano, the Basento and the Agri, and eastward of the center of action, Laurenzana, Corleto, Guardia, Aliano, Armento, Gallicchio, Missanello, Sant' Arcangelo, Castelsaraceno, and numerous other towns and villages, had most of the houses thrown down, and many inhabitants killed.

But the effects of this terrific earthquake extended far beyond the large era that has just been noticed. The two shocks of the 16th were felt, with various degrees of intensity, as far as the town of Reggio in Calabria on the south, Brindisi on the Adriatic, on the east, Vasto, also on the Adriatic, on the north, and Terracina on the west. Within these limits many towns had their buildings much injured, and some inhabitants killed. All the towns on the Adriatic, from Polignano to Manfredonia, had their buildings rent. At Canosa, 15 houses were thrown down, 155 more rendered uninhabitable, and 5 persons were killed. At Melfi and Barile, there were three deaths. In the neighborhood of Bella, a town which stands half way between Potenza and Melfi, a tract of about 600 acres was split in different directions, and surrounded with a chasm 15 feet deep, and about as wide. At Salerno, many public buildings were injured, and 4 persons killed. Even at Tramonti, near Amalfi, there were two deaths; and at Naples, the inhabitants were so greatly alarmed by the violence of the shocks, as to spend in the open air all the night of the 16th of December.

On the whole, by this terrific earthquake, at least 22,000 human beings, on a most moderate calculation, were destroyed in a few seconds. Many no doubt would have been saved had it been possible by active steps to dig them out immediately. This will account for the comparatively very small number of wounded, in all about 4000.

From the above data it will be seen that in the course of 75 years, from 1783 to 1857, the kingdom of Naples lost at least 111,000 inhabitants, by the effects of earthquakes, or more than 1500 per year, out of an average population of six millions!

Several touching anecdotes were told in the course of the narrative. In 1783, Eloisa Basili, a beautiful girl of 16, was buried under the ruins with a child in her arms, who died on the fourth

day. She was so wedged in that she could not get rid of its lifeless remains. She was dug out alive after eleven days, which she had counted from a ray of light that reached her. She recovered, but remained sad and gloomy, could not bear to see a child, would neither marry nor become a nun. She preferred solitude, turned away with a shudder from houses, and liked to sit musing under a tree, whence no buildings were seen. She pined away, and died at five-and-twenty.

More fortunate was the lot of Marianna De' Franceschi, a beautiful young lady of 20, who, in the earthquake of 1804, was dug out at Guardia Regia, after being buried for ten days and eight hours. She recovered, married, and became the mother of a numerous family.

A lady with child was dug out after 30 hours by her devoted husband, who nearly died from over-fatigue. On being asked what her thoughts were during the time, she answered, "I was waiting."

In the late earthquake, a gentleman of Montemurro, whilst escaping from the house with his wife and a large family of children, remembered that one of them had been left in bed. He rushed back to take him, but the house tumbling on every side, he remained alone on a wall. All his family were crushed to death. The blow was too great; his mind gave way, and he went raving mad. At Saponara, the judge was buried under the ruins of his house with his young wife and two children. He was dug out alive, but his wife was found dead lying across his knees with her arms outstretched towards her dead children. He was overwhelmed by his loss; ever since he has diligently fulfilled the duties of his office, but has never been heard to allude to the event, or seen to smile.

Instances were mentioned, showing how tenacious life could be under the most trying circumstances. Besides the cases of Basili and De' Franceschi already recorded, in 1783 a baby was dug out alive on the third day, and lived. At Montemurro, in December last, Maria Antonia Palermo and her two little girls, one of them only thirteen months old, were dug out on the eighth day, and lived. With some animals the length of time they had stood alive was quite remarkable. A donkey was found living yet on the fifteenth day; and in 1783 two mules and a chicken were found still alive on the twenty-second, and two pigs on the thirty-second day.

ART. XXIV.—*Notes on some of the Chemical Reactions of Strychnia;* by T. G. WORMLEY, M.D.

IN the following paper it is proposed to give the result of some experiments in regard to the relative value of the various tests which have been suggested for the detection of strychnia.

The various solutions were made with great care from pure strychnia dissolved in just sufficient quantity of acetic acid, and the reagents were generally applied by means of a glass rod dipped in a saturated solution of the reagent, to a *single drop* of the strychnia solution delivered, upon a glass slide, from a graduated burette which furnished a fluid grain in each drop. Therefore, each drop contained an amount of pure strychnia, corresponding to the fractional dilution of the solution.

1. *Ammonia Test.*

1. $\frac{1}{100}$ grain of pure strychnia in one grain of water, gives with ammonia, an immediate white precipitate, which at first is amorphous, but very soon it begins to assume a crystalline form, and in about three minutes the drop becomes a solid mass of lengthened prisms.

2. $\frac{1}{500}$ gives an immediate precipitate, but in a few seconds beautiful stellate crystals begin to form, which very soon become abundant.

3. $\frac{1}{1000}$, behaves much the same as No. 2, not so abundant.

4. $\frac{1}{2500}$, with the microscope, crystals begin to form in about a minute, in three minutes they are very obvious to the naked eye. If the drop be rubbed with a glass rod, rings of granules are very obvious to the eye in a few seconds, and the precipitate is much more abundant than when not thus treated.

5. $\frac{1}{5000}$, no indications after stirring for several minutes, except when viewed with the microscope, a few granules appear.

From the above experiments, the limit of the ammonia test, when applied to a single drop, is when it holds in solution $\frac{1}{2500}$ its weight of strychnia; however, at this degree of solution the result is very satisfactory.

2. *Potash.*

This reagent behaves much the same as ammonia, its limit being about the same. In applying this test it is important that the proper quantity be added, for if either too much or to little, no precipitate will be produced.

3. *Carbonate of Potash.*

1. $\frac{1}{100}$ grain of strychnia with carbonate of potash gives an immediate white precipitate of star-like crystals, which will redissolve if sufficient quantity of the reagent has not been added.

2. $\frac{1}{500}$, in a few seconds small granules, prisms, and a few stellate crystals begin to form, which after a little time are rather abundant.

3. $\frac{1}{1000}$, in a few seconds lengthened granules may be seen with the microscope, which in a few minutes are very obvious to the naked eye.

4. $\frac{1}{2000}$, after a few minutes small granules are very perceptible.

5. $\frac{1}{5000}$, after several minutes no indications with the microscope.

4. *Carbonate of Ammonia.*

In $\frac{1}{100}$, and $\frac{1}{500}$ solutions the same results as with carbonate of potash. In a drop of $\frac{1}{1000}$ solution no indication after 15 minutes.

5. *Iodid of Potassium.*

1. $\frac{1}{100}$ solution in a few seconds gives a white crystalline precipitate of tufts of long prisms.

2. $\frac{1}{500}$, it is several minutes before crystals begin to form, if the solution be stirred, however, they begin to appear in about two minutes.

3. $\frac{1}{1000}$, by stirring, the crystals begin to appear in about five minutes.

4. $\frac{1}{2000}$, crystals begin to form in about seven minutes.

5. $\frac{1}{5000}$, crystals can be observed with the microscope in about 10 minutes, in 20 minutes they are just perceptible to the naked eye.

6. *Sulphocyanid of Potassium.*

1. $\frac{1}{100}$, solution, gives an immediate mass of white crystals.

2. $\frac{1}{200}$, in a few seconds the crystals are very abundant.

3. $\frac{1}{500}$, by rubbing, in less than a minute the crystals are very obvious.

4. $\frac{1}{1000}$, by rubbing, in a few minutes the crystals begin to form.

5. $\frac{1}{2000}$, no indication after several minutes, with the microscope a few crystals may be observed upon the border of the drop.

7. *Tannic Acid.*

1. $\frac{1}{10,000}$, gives an immediate white curdy precipitate.

2. $\frac{1}{20,000}$, gives very good results.

3. $\frac{1}{25,000}$, after a few minutes the precipitate is quite perceptible.

4. $\frac{1}{50,000}$, after several minutes it is just possible to observe a white cloudiness.

The satisfactory limit of the test is when it is applied to a drop of fluid holding in solution $\frac{1}{25,000}$ its weight of strychnia.

The precipitate is very soluble in acetic acid, and if obtained from dilute solutions, it is, also, soluble in a drop of potash, giving a red liquid; but when produced from strong solutions, the precipitate will not all dissolve in a drop of potash solution.

8. *Bichlorid of Platinum.*

1. $\frac{1}{1000}$, an immediate yellow amorphous precipitate which soon becomes granular.

2. $\frac{1}{2000}$, an amorphous precipitate in a few moments, which soon becomes granular.

3. $\frac{1}{5000}$, the results are very good in a few minutes.

4. $\frac{1}{10,000}$, if the solution be rubbed, small granules begin to appear in a few minutes, and soon the result is satisfactory.

9. *Terchlorid of Gold.*

1. $\frac{1}{1000}$, gives a bright yellow amorphous precipitate, which soon becomes partly granular; most of the granules float upon the surface of the drop. A portion of the precipitate collects into little yellow flakes.

2. $\frac{1}{2000}$, gives much the same reaction as No. 1, not so abundant.

3. $\frac{1}{10,000}$, gives an almost immediate precipitate.

4. $\frac{1}{20,000}$, gives very satisfactory results.

5. $\frac{1}{50,000}$, at this degree of dilution the precipitate is still perceptible, but not satisfactory.

When the precipitate obtained from a solution containing $\frac{1}{2000}$ or less of its weight of strychnia is boiled, the precipitate will dissolve and give a yellow solution, from which it will again be deposited, with little or no change upon becoming cool. If the solution contains more than $\frac{1}{2000}$ its weight, the precipitate will not entirely dissolve upon boiling, after cooling there will generally be a metallic gilding upon the sides of the tube. The precipitate from $\frac{1}{2000}$ or more dilute solutions, will readily dissolve, without much change of color, upon the addition of a drop or two of potash solution; if then the mixture be boiled it will give a fine purple color, with sometimes a purple precipitate. When the precipitate is from a stronger solution than above stated, it does not readily dissolve in a solution of potash, and when the mixture is boiled it behaves as above.

10. *Chromate of Potash.*

1. $\frac{1}{100}$, gives an immediate mass of yellow crystals, soluble in 30 drops of strong acetic acid.

2. $\frac{1}{1000}$, crystals begin to form in a few seconds, but they are not very abundant after standing 15 minutes.

3. $\frac{1}{2000}$, with the microscope, a few prisms may be observed in 8 minutes, but no indication to the eye, after standing 20 minutes.

11. *Carbazotic Acid.*

ınd the three following tests have been formerly recom-
n the lectures of the writer, the only account of them
ı the last edition of Taylor on Poisons, in which the
ıt is suggested.

oholic solution of carbazotic acid will give with—

, grain of strychnia, an immediate amorphous yellow
e soon becoming twig-like tufts.

ɪ, in a few seconds a precipitate soon becoming as in

ɪ, by rubbing a few seconds, a copious deposit of gran-

ɪɪ, in about a minute the same as No. 3.

ɪɪ, in a few minutes small granules are very obvious.

12. *Bichromate of Potash.*

, an immediate brilliant yellow mass of dendroidal crys-

ɪ, in a few seconds same as No. 1.

ɪ, crystals begin to form in a few seconds, in a few
hey are abundant.

ɪɪ, in a few minutes beautiful octahedra appear, resem-
se of oxalate of lime. If the solution be rubbed the
ecomes rather abundant.

ɪɪ, by rubbing, in a few minutes crystals are obvious
microscope, in several minutes they are readily seen
eye.

recipitate produced by this reagent is not as readily
ı acetic acid, as that produced by the protochromate of

13. *Iodine.*

various tests recommended for strychnia, this is the
cate. It was applied in the following experiments, by
ɪ three grains of iodid of potassium in one fluid drachm
and then adding to the mixture one grain of iodine.

ɪ, immediately a copious brownish yellow amorphous
e soluble in alcohol and ether, but only soluble in large
acetic acid. The precipitate partially dissolves in a
ı of potash solution, but it is immediately replaced by
hite precipitate.

ɪ, the precipitate entirely dissolves in potash, and is re-
the white one.

ɪɪ, gives same results as No. 2, not so abundant.

ɪɪ, the precipitate dissolved in potash gives a very
te precipitate.

ɪɪ, the precipitate is immediately produced and soon
ıto little yellow flakes.

6. $\frac{1}{100,000}$, if the drop be touched with a small drop of the reagent upon the end of a glass rod, it gives an obvious precipitate.

If a few drops of the last named solution be placed in a small test tube, and a drop of the test fluid be placed upon the inside and allowed to flow into the solution, when they meet, yellow streaks will readily be observed, and the solution will become turbid.

14. *Bromine.*

This reagent was prepared by saturating a strong solution of hydrobromic acid, with bromine.

1. $\frac{1}{1000}$, gives an immediate bright yellow amorphous precipitate.

2. $\frac{1}{10,000}$, a yellow precipitate, having a greenish tinge.

3. $\frac{1}{50,000}$, a dirty yellow precipitate, which after several minutes nearly all dissolves.

4. $\frac{1}{80,000}$, the precipitate is still perceptible, but not satisfactory.

15. *Color Test.*

It is well known, that if strychnia or its salts be dissolved in sulphuric acid, and then a small quantity of bichromate of potash, ferridcyanid of potassium, peroxyd of lead, or of peroxyd of manganese be added, a series of colors are developed. This is known by the name of the "color test." This test succeeds best in the following manner: place the strychnia, or a drop of the solution evaporated to dryness, in a watch glass, and by its side a drop of strong sulphuric acid, into which a fragment of bichromate of potash is introduced and stirred until it imparts a yellow color, then by inclining the watch glass the colored acid is allowed to flow over the strychnia.

1. $\frac{1}{1000}$ grain of strychnia in one drop of water, gave in a majority of a number of experiments, very satisfactory results, however, in some the reactions were just perceptible. In solutions stronger than the above the results were always good.

2. $\frac{1}{5000}$, in many cases no indication whatever, in others a very faint trace of color was obtained, which however rapidly disappeared. In no instance was the indication such as should be relied upon for medico-legal purposes.

3. $\frac{1}{1000}$ grain, dry, will always give a fine reaction. By allowing the acid to flow upon a portion of the deposit at a time, several indications may be obtained from the same deposit.

4. $\frac{1}{5000}$, dry, in a majority of instances the indications were very good; in some, however, they were very faint. The success of the experiment depends much on the character of the deposit left by evaporating the solution to dryness; sometimes, the principal part of it is in the form of a ring, which when examined with the microscope consists of well defined crystals; at

hers, it is a confused mass distributed over the space occupied r the drop. In the latter case the indications will not be near- so good as in the former.

5. [illegible], $\frac{1}{500}$, dry, in a number of cases manipulated differently, e majority gave no indications, some few gave a slight trace, it in no instance was the indication sufficient.

As the color test is relied upon, perhaps, more than any other r medico-legal purposes, it is important to remember that it is terfered with by the presence of morphia. When one part by eight of strychnia is mixed with—

1. 1 part of morphia, it gives very good results. The colors, owever, are not so bright as with strychnia alone.

2. 1½ of morphia, in a very small quantity of this mixture the dication of strychnia is very good, in a larger quantity, about r gr., the reaction is just perceptible.

3. 2 of morphia, the indication in a very small quantity is pret- fair, but in about $\frac{1}{50}$ gr. there is only a mere trace.

4. 3 of morphia, in a very small quantity of this mixture, ie reaction is just perceptible, but in a larger amount there is o reaction indicative of the presence of strychnia.

Columbus, Ohio, July 18, 1859.

RT. XXV.—*On the Consolidation of Lava on Steep Slopes, and on the Origin of the Conical Form of Volcanoes;* by Sir CHARLES LYELL, M.A., D.C.L., F.R.S.*

DURING two recent excursions made in the autumns of 1857 id 1858 to Mount Etna, Sir C. Lyell had an opportunity of ex- nining sections of lava-currents of known date, which had scended steep slopes, and had consolidated thereon in tabular id stony masses, the inclination of which sometimes exceeded)°. This fact has an important bearing on the theory of craters of elevation," it having been affirmed by geologists of igh authority, that when lavas congeal on a declivity exceed- ig 5° or 6°, they never form continuous beds of compact stone, ut consist entirely of scoriaceous and fragmentary materials.

The origin of such mountains as Etna and Vesuvius had of ld been referred to the cumulative effect of a long series of or- inary eruptions, it being seen that reiterated showers of ashes id streams of lava were often poured out from a permanent entral vent. This opinion was advocated by Mr. Scrope in his ork on volcanoes in 1825, and by Sir C. Lyell in his *Princi- les of Geology*, after his exploration of Vesuvius and Etna in 828; both authors considering the injection from below of

* Proc. Roy. Inst. of Great Britain, April, 1859.

melted matter, in the shape of dykes, as part of the cone-making process.

But in place of this simple explanation of the phenomena, Von Buch substituted the following hypothesis: that a vast thickness of horizontal or nearly horizontal sheets of lava and scoriæ, having been first deposited, an expansive force operating from below, exerts a pressure both upwards and outwards, from a central axis towards all points of the compass, so as suddenly to uplift the whole stratified mass, making it assume a conical form; giving rise at the same time, in many cases, to a wide and deep circular opening at the top of the cone, an opening called a "crater of elevation."

In all great volcanoes of which sections can be obtained, there are some layers of compact stone, inclined at angles of 10°, 20°, and sometimes much higher angles, and these beds are often among the uppermost, or last formed of the whole series. Hence it was logically inferred, when once the law above laid down respecting the consolidation of melted matter had been accepted, that every mountain containing such inclined and compact layers, must owe its conical form almost exclusively to the development of mechanical force exerted at the close of the volcanic operations, or after all the alternating lavas and scoriæ were heaped up. The hypothesis of a sudden and violent movement was perhaps the more readily embraced, because it relieved its advocates from the necessity of making unlimited drafts on past time, thousands of centuries being required if lofty cones, like Mount Etna, are to be built up by successive eruptions of ordinary intensity. The magnitude also of certain craters or "calderas" (implying, probably, one or more great explosions, followed by aqueous erosion), and the occasional steepness of the dips of certain lavas, beyond that which is found on the flanks of ordinary cones, (many of which might have been assigned to local dislocation), afforded additional arguments in favor of the new hypothesis. The lecturer then gave a rapid review of the controversy respecting "craters of elevation," stating the objections made to it by English and continental writers, including the late M. Constant Prevost; and he went on to observe that the principal object of this discourse was to show that the law laid down by M. E. de Beaumont, and by the late M. Dufrenoy, as governing the cooling and solidification of lava currents, on steep slopes, has no foundation in fact. Signor Scacchi had already, in 1855, seen and described a compact stony lava which in that year had flowed down the flanks of Vesuvius from near the margin of the great crater to the base of the cone in the Atrio del Cavallo, having a thickness of from 1½ in the upper to 4½ in its lower part, and dipping at angles varying from 32° to 38°. The interior of this current was laid open to view by a rare accident,

r, the sinking down in the same year (1855) of a certain n of the north flank of the cone, whereby one side of the va stream was engulphed, and a section of the remainder ed visible. Although this current had cooled on an aver- clivity of 35°, it was as compact and as free from vesicles y lavas which have congealed on level ground at the foot suvius.*

first exemplification of a similarly inclined stony lava of date on Mount Etna, described by the lecturer, and of a pictorial representation was given, occurs in a ravine the Cava Grande, near Milo, about 17 miles north of a, and 7 from the sea, above the level of which it is eleva- out 2000 feet. A branch of the lava current of 1689 ding from the Val del Bove, cascaded over the right bank t ravine 220 feet high, and on cooling, formed a tabular nore than 16 feet in thickness, inclined at an average angle ut 35°, and concealing the face of the precipice for a width ut 400 feet. The internal structure of this new lava has xposed to view by the falling down and partial removal of oriaceous crust on the left side; a removal caused by the l waste of the steep bank of the ravine produced by the of rain, and the torrent which flows at the bottom. The intersects alternating beds of tuff, scoria, and lava, slight- lined to the east, or seawards, being a series of the older cts of Etna. This new and steeply inclined lava consists ee parallel layers, an upper fragmentary and scoriaceous bout 8 feet thick; a central stony layer, 5 feet thick; and r bed consisting of thin strata of fragmentary scoriæ, in all feet thick, but the bottom part of which is not visible. ompact central portion is a dolerite or trachi-dolerite, con- g crystals of feldspar with some olivine, and is of the ordi- pecific gravity of trap. It is divided by joints, 9 or 10 feet so that among the fragments detached by denudation, and d over the sloping bank and bottom of the ravine, are an- masses of huge size, with a fracture like that of many t igneous rocks. The normal thickness of this bed of ct dolerite is 5 feet, where it dips at 32° and 35°, but near p where it first enters the ravine, and where the inclination ses to 45° and 47°, the thickness is reduced to one-half or t; yet when dipping at 47°, it is still not only stony and ct, but there is no breach whatever of continuity in the and not more joints than in the less inclined portion. This n of the lava of 1689, which has given a new facing to part right bank of the Cava Grande, exhibits but slight in-

* is section, seen by Signor Scacchi in 1855, was looked for by Sir C. Lyell, any with Signor Scacchi in 1857, and found to be totally buried and con- y the lavas poured out in the early part of that year.

equalities on its surface, appearing almost even when contrasted with the main current of the same date, from the surface of which many parallel and longitudinal ridges project prominently, sometimes 40 feet above their base, and with very steep sides sloping at angles of from 35° to 70°. The dip of the main current is between 10° and 16° east. From this and other examples, it is inferred that wherever the slopes are excessive (between 25° and 45°) the surfaces of the cooling lavas are less rugged than where the melted matter has congealed on more level ground.

Allusion was next made to some lavas which have cascaded over sea-cliffs 500 feet high, between Aci Reale and Santa Tecla. One of these at a place called the Scalazza of Aci Reale, exhibits a longitudinal section of a tabular mass of stony rock 20 feet thick, inclined at angles of 23° and 29°, which is connected uninterruptedly with the main body of the same lava resting on the gently sloping platform above, of which the sea-cliff is the abrupt termination. The above-mentioned highly inclined stony lava is covered as usual by a parallel layer of scoriæ (in this case 12 feet thick) and its base consists of another bed of scoriæ of slight thickness.

Several other sections of modern lavas of Etna, which have not been disturbed in their position since the day of their formation, and which are inclined at angles exceeding 30° were then enumerated. For a detailed account of those, reference was given to a paper by the lecturer, recently published in the *Philosophical Transactions* (Part 2 for 1858, p. 703). Among them is a current, inclined at 35°, occurring in the Cava Secca, a deep valley near Zafarana; and another reposing on the face of the great precipice at the head of the Val del Bove, under the sunk space called "The Cisterna." This remarkable current has a mean inclination of 35°, and the central stony layer is seven feet thick. Above and below are parallel overlying and underlying masses of scoriæ five and seven feet thick respectively. The flanks of the stream have been undermined and denuded by that constant waste which makes the innumerable dikes to stand out in relief on all the precipices surrounding the Val del Bove. Perhaps, also, in this instance, the lateral excavation of the lava may have been assisted by a rush of water like that of 1755, commonly called Recupero's flood, which descended the same precipice, the "Balzo di Trifoglietto." Suggestions were then offered on the probable cause of that singular inundation, which swept in a few hours from near the summit of Etna through the Val del Bove to the sea. The Canon Recupero traced its course, a few months after the event, by following the line of sand and boulders which it had left in its track; and calculated that the volume of water was so great, that, had all the snows of the top of

Etna been melted instantaneously, they could not have furnished enough water for the deluge. He, therefore, concluded that the water was vomited forth from the summit crater itself. Sir C. Lyell conjectures that there may have been masses of ice in the cone during the eruption which is recorded to have accompanied the flood of 1775, and the ice may have been suddenly melted by hot vapors and injected lava. In support of this hypothesis, he mentioned his having ascertained the continued existence, in 1858, of the same glacier which was alluded to by him in the first edition of his *Principles of Geology*, as occurring at the base of the cone, which had been quarried before 1828. This mass of ice the Catanians again quarried, four years ago, to a depth of four feet, without reaching the bottom. It is covered by ten feet of volcanic sand, and this again by lava. The tale of the mountaineers, who assured Recupero that the water of the flood of 1775 was hot, may have been correct, if the origin here assigned it be true.

Some account was next given of the lavas of 1852–53, which were still hot, and emitting columns of vapor at the time of Sir C. Lyell's last visit. They were more voluminous, perhaps, than any ever poured forth from Etna in historical times, except those of 1669, which overflowed a great part of the city of Catania. The narrative of the people of Zafarana, of the manner in which the frontal wall of lava, 30 feet high, and inclined at an angle of 37°, had crept slowly over green pastures and vineyards, and overwhelmed habitations in the suburbs of that town, reminded Sir Charles of similar tales which he had listened to seven weeks before in the Alpine valley of Zermatt, where the great glacier had, in the preceding spring, been pushing onwards with irresistable force, an equally steep mound of stony fragments, forming the frontal moraine by which green meadows, gardens, and chalets had been overwhelmed. A description was then given of the changes brought about by the lavas of 1852–53 in the scenery of the Val del Bove, and in that of the lower Valley of Calanna, in the interval since 1828, when the lecturer first visited Etna. These changes are very striking; the fresh currents having run from the head of the Val del Bove both in a northeast and in a southeast direction for a distance of six miles, with a breadth in each case of two miles, and having been piled up one over the other in some places (as at the Porella of Calanna) to a depth of more than 100 feet. The longitudinal and nearly parallel ridges on the surface of this new lava field are from 20 to 70 feet high; and there is now a black and monotonous wilderness in many places, where, in 1728, there were verdant forests.

One branch of this lava of 1852 cascaded over a precipitous declivity 500 feet high, at the head of the Valley of Calanna, and consolidated at angles of 35°, 45°, and even 49°. The scoriaceous crust having been partially washed off, the surface of a continuous crystalline and stony mass is exposed to view, only moderately vesicular, and having the steep inclinations above alluded to. This same current rests on an older one, that of 1819, which passed down the same steep cliff, and which has at some points a dip of more than 40°.

[The author continues with facts and reasonings similar to what is published in his paper of last year (this Journal, vol. xxvi, p. 214)]:

In conclusion, the lecturer gave a brief sketch of the series of geological events which he supposed to have occurred on the site of Etna since the time of the earliest eruptions, events which may have required thousands of centuries for their development. The first eruptions are believed to have been submarine, occurring probably in a bay of the sea, which was gradually converted into land by the outpouring of lava and scoria, as well as by a slow and simultaneous upheaval of the whole territory. The basalts, and other igneous products of the Cyclopean Islands were formed contemporaneously in the same sea, the molluscous fauna of which approached very near to that now inhabiting the Mediterranean; so much so, that about nineteen-twentieths of the fossil species of the sub-Etnean tertiary strata still live in the adjoining seas. Hence, as that part of Etna which is of subaerial origin is newer than such fossils, the age of the mountain is proved to be, geologically speaking, extremely modern. During the period when the volcano was slowly built up, a movement of upheaval was gradually converting tracts of the neighboring bed of the sea into land, and causing the oldest volcanic and associated sedimentary strata to rise, until they reached eventually a height 1200 feet (and perhaps more) above the sea level. At the same time the old coast line, together with the alluvial deposits of rivers, was upraised, and inland cliffs and terraces formed at successive heights. The remains of elephants, and other quadrupeds, some of extinct species, are found in these old and upraised alluviums. Fossil leaves of terrestrial plants also, such as the laurel, myrtle, and pistachio, of species indigenous to Sicily, have been detected in the oldest subaerial tuffs. At first the cone of Trifoglietto, and probably the lower part of the cone of Mongibello, was built up; still later the cone last-mentioned, becoming the sole centre of activity, overwhelmed the eastern cone, and finally underwent in itself various transformations, including the truncation of its summit, and the formation of the Val del Bove on its eastern flank. Lastly, the phase of lateral eruptions began, which still continues in full vigor.

. XXVI.—*Diluvial Striæ on Fragments in Situ;* by O. N. STODDARD, Prof. Nat. Science, Miami University.

'HILE examining a few days since the fossils and the striæ uining to the Silurian formation of this vicinity, I discovered el, small boulders, and fragments of the underlying rock, much worn by diluvial agencies and manifestly now lying :e they were when striated. They were nearly uncovered : three years since in forming a bed for a railroad; the re- ing denudation has been accomplished by the action of the upon the unfinished and unprotected bed.

ıey have been exposed along the road for about fifteen feet, across nearly the whole breadth. At one point the material a mass of gravel closely packed, and covering several re feet; at other places fragments of Silurian limestone, gled promiscuously with small boulders of granite, green- e, hornblende and quartz, the whole embedded in compact The striated surfaces were in the same plane, and at one t the underlying rock was exposed, also striated. The di- on of the grooves varied from 5° to 8° south of east.

o one, I presume, will for a moment entertain the idea, that one hundred and forty-one pieces composing this bed were sported to this spot, having been striated elsewhere, and ac- ıtally deposited with their surfaces in the same plane, and grooves substantially parallel. The chances against such ccurrence are so enormous, that we might with safety say, uld not happen except by miracle.

ıe bearing of this example upon the different theories of vial action is obvious. The agency of running water may ismissed as utterly inadequate to explain the facts in ques- Icebergs driven onward by the waves and currents of a ozoic sea afford a solution but little more plausible. Ice- s might plough up the bottom and scatter the fragments, could not retain them in place and striate them. It seems ssary to admit that they were firmly frozen into the clay thus held in position, while some overlying mass slowly ind off their exposed surfaces. If we admit that the bed was in during the striating process, then must we also admit it could not have been covered at that time by any consider- depth of water. It is hardly necessary to state to a geolo- that no known agency so admirably meets all the conditions iis case, and no supposition so satisfies the mind as this, that iers once overspread this region, holding the beds under- h frost-bound; and, while their enormous pressure down- ls, prevented displacement in an upward direction, their ion towards the south, ground down, not only the rocks in

place, but also these fragments, almost as firmly fixed by frost as the rocks themselves. On examination, a few of the pieces were found to be grooved on the under surface also. In one or two cases the striæ on opposite sides were nearly parallel, but generally inclined at a considerable angle.

Probably these fragments were at first embedded in the glacier and received, while in that position, the scratches on their under surface, but were subsequently detached from the glacier, embedded and frozen in the clay, where they were reduced to the condition in which they were found.

It may not be amiss to remark in conclusion, that striæ are abundant upon the surface rocks of this region, their direction varying from 1° to 11° east of south. The most durable boulders generally exhibit upon one or more of their surfaces distinct traces of the same abrading agency.

Miami University, June 11th, 1859.

ART. XXVII.—*Vibrations in the Waterfall at Holyoke, Mass.*; by Prof. E. S. SNELL, Amherst College.

AT the meeting of the American Scientific Association held in Montreal, August, 1857, I read a paper on the vibrations of the fall at Holyoke, in which I attributed the movement to the rarefaction of air in the tube behind the sheet, this rarefaction being caused by the action of the water, which carries down the adjacent air, and throws it up in foam mostly on the outside of the fall. In that paper I described two modes of vibration which I had observed, that agreed well with the supposition of acoustic pulsations in a tube of air 1008 feet long, and having *two* nodal sections in one case, and *four* in the other. I also stated my impression that I had, many years before, noticed a much slower rate of vibration, which accorded equally well with the existence of *one* nodal section in the tube.

Since the reading of the above-mentioned paper, I have observed the condition of the fall at four different times. In October and November, 1857, I noticed the same rates of vibration very nearly, which I had previously reported. But on the 16th of April, 1859, I found the water four or five feet deep on the edge of the dam, the temperature of the air about 45°, and the number of oscillations only *eighty-two* per minute. Again, on the 25th of July last, I found the water lower than I had seen it before, (less than three inches deep,) and no vibrations, either in the sheet, or the air at the end of the cavity behind it.

There are, therefore, at least *three* very different rates of vibration in this fall, the slowest when the depth of water is greatest,

nd the most rapid when it is about one foot deep, the vibrations easing altogether when the depth is so small as three inches. n the following tabular statement, the four first columns show at nce the facts as they stand connected in the few observations hich I have made, and the last column contains the numbers alculated for an open tube 1008 feet long, with *four* nodes for he *third* and *fourth* observations, *two* nodes for the *first*, *second*, nd *fifth*, and *one* node for the *sixth*.

	Time of observation.	Temperature of air.	Depth on Dam.	Observ'd No. vibrations per min.	Calculated No. vibr. per. min.
1	July 25, 1857,	80°	2 feet	137	186
2	July 29, "	75	2 "	136	136
3	Aug. 6, "	75	1 "	257	271
4	Oct. 7, "	65	1 "	258	268
5	Nov. 24, "	80	2 "	140	129
6	Apr. 16, 1859,	45	5 "	82	66
7	July 25, 1859,	70	3 inches	none	none

I used the formula in Peirce's Treatise on Sound, $N = n\frac{V}{L}$, where N is the number of vibrations, n the number of nodes, V the velocity of sound, and L the length of the tube. It is observable, that the calculated rates are higher than the observed, in the cases of most rapid vibration, and lower, in those of least rapidity, while in the medium rates, they very closely agree. As to the seventh case, the sheet was so thin, that it was divided into filaments and broken into spray, and the air had free ingress and egress through its whole length; the acoustic tube being thus destroyed, no vibrations could be produced.

Notwithstanding the discrepancies between the numbers in the two last columns, I think the general correspondence between them points to the true nature of the cause, especially when taken in connection with the fact, that the pulsations are noticeable only in the water and in the air,—not at all in the dam itself, nor in the rock or soil immediately adjacent. It must be remembered also, that the pitch of musical pipes does not fully conform to the formulæ, but varies with the breadth of opening and the mode of exciting vibrations.

This seems to be one of the numerous cases, in which the body which excites vibrations in another, is itself thrown into synchronous vibration by reaction, and then, by its own inertia or elasticity, controls the common rate of both. The sheet of water in its descent first produces rarefaction of the enclosed air by removing a part of it. The immediate effect is a collapse of the sheet of water, as well as a rush of air in at the ends. But the inertia of a thick mass of water will prevent its recovering its natural position so soon as if it were thinner; hence, the air-column divides itself into such a number of segments, that the water and the air can adjust their movements to each other.

In a manner somewhat like this, a stream of air from the lips, driven across the embouchure of a flute, excites vibrations in the column of air, with such frequency that it can itself vibrate in unison with it. But, if the stream is blown more and more swiftly, its elasticity will at length be too great for so slow a rate, and then the column will divide into shorter segments, and the two will continue their vibrations harmoniously upon a higher key. A skillful player can in this way by his mere breath produce *six* or *eight* harmonic notes on the flute, when all the holes are closed.

At the time when I witnessed the comparatively slow oscillation of 82 per minute, I was surprised by the great strength of the current of air, as it rushed into the opening at the end of the dam. I could not venture within the passage through the pier, lest I should be swept in behind the sheet; nor could I stand at the entrance of the arch, without bracing myself, by placing both hands on the corners. There was, however, no alternate *outward* blast, but only a lull, or cessation of all motion; which shows, that the excess of air that pours in at every pulse, is carried out again in some other way; and there is no conceivable way for it to escape, except to be driven down by the falling water, and poured up externally in a bed of foam. It had never occurred to me before, that the velocity of the air-current must be greater, the longer the interval between the pulses, since the rarefaction within the tube will be greater nearly in the ratio of the same interval.

In September, 1857, a paper was read before the Boston Society of Natural History, in which objections were made to my view of the source of the vibrations, and the cause assigned for them was the impulse on the rock produced by successive swells of the sheet, extending parallel to the edge of the dam, from one side of the river to the other. If this is the cause, then the vibrations are first excited in the rock, and communicated thence to the air. But the *rock* and *soil* in the immediate vicinity of the Holyoke fall are not perceived to move in the least, while the *air* sways a loose garment back and forth three or four inches, keeping time with the visible and audible pulsations of the sheet of water, and at the end of the tube sometimes rushes so violently, that a man can scarcely stand against it. That alternate swells and contractions cannot exist in a falling sheet of water, and if so, that they cannot cause sensible undulations in the earth, I am not prepared to assert; but I believe that any unbiased observer will find it quite absurd to apply such an explanation to the strong puffing of the air which is usually so noticeable at the Holyoke fall.

ART. XXVIII.—*Caricography;* by Prof. C. DEWEY.

(Continued from vol. xxiv, p. 48, Second Series.)

No. 254. *C. alata,* Tor. Mon.

Spica composita; spiculis 5–8, ovalibus, sessilibus, crassis, superne aggregatis, densifloris, infirne staminiferis; fructibus suborbiculatis, interdum obovatis, distigmaticis, subplanis, abrupti brevi-rostratis, bidentatis, lato-alatis, rostro subscabris, squama ovato-lanceolata brevioribus.

Culm 3–4 feet high, smooth, with rough edged leaves; pale green; stigmas two. North Carolina and Georgia—*Torrey;* Florida—*Chapman;* a pine sedge-grass.

255. *C. striata,* Mx. Boott, Illust., No. 141.

Spicis staminiferis, 1–4, sæpe 2, oblongis, cylindraceis, erectis, subrubris, inferioribus sessilibus et brevioribus; pistilliferis 2, raro 1, oblongo-cylindraceis, erectis, bracteatis, densi-floris, suprema sæpe apice staminifera, tristigmaticis; fructibus ovatis acuminatis sub-inflatis brevi-rostratis scabro-pubescentibus nervosis ore bifidis, squama ovata acuta fusca vel sub-rubra albi-marginata duplo longioribus.

Culm 1–2 feet high, erect, stiff, leafy-bracteate, longer than the striate and lanceolate leaves, reddish at the root.

Penn.—*Muhlenberg;* New Jersey—*Torrey* and also *Kniers-kern;* Florida—*Chapman.*

Confounded with *C. polymorpha,* Muh.; but Dr. Boott found the Florida plant, fully like the others, to be *C. striata* in the Herbarium of Micheaux. This discovery makes a change in its designation: it led also to the other changes. Thus,

C. Halseyana, vol. xi, p. 313, of this Journal, becomes var. 2 of *C. polymorpha,* Muh. Gram. p. 239. Boott, Illust., No. 56. If this change should prove untenable, the original name can be restored. Years after *C. Hals·yana* was named, I found it with different forms, named polymorpha in Muhl. herbarium.

256. *C. utriculata.* Boott. Illust., No. 37.

Spicis staminiferis 3–4, cylindraceis, erectis, gracilibus; pistilliferis 2–4, sæpe 3, longo-cylindraceis magnis subremotis, sæpe apice staminiferis, sessillibus, longo-foliaceo-bracteatis, infirma inferne attenuata et *laxiflora* et sub-pedunculata fructibus tristigmaticis ovati-oblongis vel ovata ellipsoides, cum rostro terati et bifurcato, glabris, subinflatis, stramineis, revorsis, squama lanceolata purpurea, angusta scabro-aristata longioribus.

Culm 2–3 feet high, erect, strong, shorter than the broad stiff rough nodose and reticulate-veined leaves; plant glaucous-green, except the yellowish spikes.

Abundant over the country by streams.

Confounded in our country with *C. ampullacea*, but separated some years since by Dr. Boott in Hook. Flor. Bor. Am.

C. ampullacea var. *utriculata*. Carey in Manual, and this var. much the most common.

Var. sparsiflora, Dew. All the spikes long, 3–6 inches, slender, and the pistillate quite loose—flowered and more lax below and attenuated; fruit smaller, and scale longer.

Note.—The following changes in the names of some species, already described in this Journal, become necessary, and some corrections.

C. gynocratis, Wormsk. is due to that difficult form, *C. davalliana*, Wahl., vol. x, p. 283 of this Journal, and the characters need to be more full.

C. gyrocratis, Wormsk. Kunze Supp., t. 31.

Spica unica, dioica; pistillifera oblonga sublaxiflora; fructibus sub-ovalibus vel oblongis basin teretibus, nervosis, cum rostro convexo-tereti sub-brevi recto vel sub-recurvo bidentato, maturis sub-horizontalibus, squama ovata acuta paullo longioribus.

Culm 4–6 inches high, roundish, glabrous, sulcate, longer than the strong, linear, sub-recurved leaves.

Wayne Co., N. Y.—*Dr. Sartwell*, as well as Greenland and Alpine Lapland.

C. tenella, Ehrhart, not Schk., is the oldest name of *C. Persoonii*, Sieb., in this Journal, vol. xix, p. 253, Second Series. For synonyms, see also Carey in Manual, 514. This name of Ehrh. is the true designation.

C. lenticularis, Mx. Boott, Illust. No. 76.

Since the description of this species in this Journal, vol. v., p. 175, Second Series, it has been found on the White Mts., N. H., also at Lake Avalanche, N. Y.—*Torrey* and *Gray*. Staminate spike 1, rarely 2; pistillate spikes 2–5, cylindric, obtuse, and distigmatic; fruit oval or ovate, short-rostrate.

ART. XXIX.—*Description of Nine new species of Crinoidea from the Subcarboniferous Rocks of Indiana and Kentucky;* by SIDNEY LYON and S. A. CASSEDAY.

IT was our intention originally, to publish the description of these, and other western Crinoidea, in the fourth volume of the Report on the Geology of Kentucky; but as many of our new and most interesting fossils find their way to the cabinets of European palæontologists and are described by them in continental journals, we determined to lay before the public the results of our labors at the earliest possible moment. We have drawings of all the species described, which we will publish sometime during the winter of the present year.

GONIASTEROIDOCRINUS, n. g., Lyon and Casseday.

Generic Formula.

Basal pieces, 1×5, pentagonal perforation not visible.
Subradial pieces, 5, hexagonal, nearly equal in size.
Primary radials, 3×5, first radial spinigerous.
Secondary radials, 3×10, hexagonal.
Interradial fields, 5×13, to 14.
Interbrachial fields, 5×7, to 9.

Arms, 5, nearly round, composed of about seven rows of small hexagonal pieces resting midway between the primary radials and supported by a right and left branch of the alternate ray on each side of them severally. Non ciliate. The interbrachial fields support long, pendulous cilia, from five to seven in each field.

Summit, pentagonal, composed of numerous polygonal pieces, some of which form raised folds enclosing fields of smaller pieces. Mouth depressed, sub-central.

Column, round, stout, composed of thin pieces alternately larger and smaller, the larger are the thickest.

The generic name was suggested to us by the resemblance of the summit to a Goniaster.

Goniasteroidocrinus tuberosus, n. sp.

Body, general form subcylindrical, or like a rounded pentagon, a little higher than wide, base deeply excavate. Summit plane or slightly elevated near the centre; the first radials are prolonged downwards and outwards into a spinous process.

Basal pieces five, forming together a regular pentagon; nearly covered by the supra columnar piece.

Subradials five, large, hexagonal, nearly equal in size, joined together, the margin presents four angular, and five plain margins between the

angular notches. The basal, subradial and part of the first radial pieces are seated in the basal pit.

Radials. The first, five in number, are septagonal and spinigerous. The second, five in number, are hexagonal and a little smaller than the first radials. The third radials also five, are septagonal and axillary, their upper oblique margins each supporting three brachials which are hexagonal and reach to the free arms; the brachials are a little smaller than the radials.

Interradial fields. These are five in number, almost identical in size, form, number and arrangement of the hexagonal pieces which compose them. The first rests upon the square end of the subradials, supporting on its upper margin a row of four or five hexagonal pieces gradually diminishing in size from below upwards. The outer oblique margins of the first interradial support each a row of four or five pieces similar to the middle row, these fit into the angular spaces between the middle row of the interradial field and the radials on either side, and reach the arm at the summit of each interradial field.

All the pieces of the calyx rise into a pointed knob near their centres, from which runs a raised fold or rib to the centre of all the surrounding ones. The knobs and ridges of the radials and brachials are more prominent than those of the other pieces: on old specimens the ribs become obliterated and the centre of the pieces more prominent. The basal and subradial pieces have plane surfaces.

Interbrachial fields. These spaces are covered by from seven to nine small pieces, forming together a scutiform console or supporting piece. They stand prominently above the general surface of the body; the lowest is the largest, the others are similar to those forming the arms.

Arms. The arms are five in number, composed of seven or eight rows of small hexagonal pieces. At a short distance from the body the arms branch and terminate in a point, the pieces becoming gradually smaller from the body outward, and the number of rows diminishing. The arms bear no cilia and are always found pendulous. Midway between the arms and attached to the superior margin of the interbrachial fields and depending therefrom, are from five to eight long delicate plumose cilia; they are composed of two or more rows of hexagonal pieces the same size throughout their whole length; they bear delicate pinnules which curve upwards.

Summit, flat or slightly elevated, nearly a regular pentagon, covered by a great number of polygonal pieces which are elevated into rounded knobs. About the centre is a cluster of pieces, (a central piece surrounded by five, six, or seven others,) very much larger than the remainder from which proceed strong, curved ridges meeting at the arms, and enclosing five sunken fields which vary in size and in the number of the pieces forming them. Without and along the margin are five fields, irregular in size and form, consisting of from six to fifteen pieces. The mouth is situated near the centre in the largest field on the summit, and can always be distinguished by the greater number and smallness of the pieces surrounding it, it is round and depressed.

Dimensions.

Diameter on second radials, - - - - -	1·00	inch.
Height from base to arms, - - - - -	·20	"
Length of spines on first radials, - - -	·20	"
Greatest diameter of summit, - - -	1·20	"
Least diameter of summit, - - - - -	·80	"
Greatest height of summit, - - - - -	1·00	"
Length of arms of a specimen whose summit diameter is 1$\frac{20}{100}$ inch length to bifurcation,	·70	"
Length of longest branch, - - - - -	1·10	"
Length of ciliated branch, - - - - -	1·60	"
Thickness of ciliated branch, - - - - -	·5	"

Geological position and locality. Found in the beds near the top of the knobstone member of the subcarboniferous beds on Clear Creek, Hardin Co., Ky., also in the same geological position in Washington and Montgomery Counties, Indiana. Its vertical range is quite limited. A crinoid (*Acanthocrinus longispina*) closely resembling ours has been found near Coblenz, and at several other Rhenish localities. It was first described by F. A. Roemer in 1850,* and again in 1854 by Zeiler and Wirtgen,† the differences are such that we unhesitatingly refer our fossil to a new genus. The columns are very unlike. Although closely resembling each other in the interradial and anal fields, and the number of radials, yet they differ widely in the arrangement of the brachials as they approach the arms, the interbrachial fields and the summit. Instead of from sixty to eighty arms all similar, our genus has only five larger arms and several smaller fimbriated appendices (arms?) Besides one is from Devonian rocks whilst the other is only found in Sub-Carboniferous strata.

Forbesiocrinus, De Koninck and Le Hon.

Forbesiocrinus multibrachiatus, sp. nob.

Body subglobose where the arms are folded inward as is usually the case; from the base to the free arms somewhat discoid, robust, externally covered with minute granules.

Basal pieces, three, similar in form and size, forming by their outer margins apparently the upper joint of the column, slightly thickened opposite the middle of the pieces.

Subradial pieces, five, in good specimens presenting five obtusely angular pieces disconnected from each other, resting apparently upon the supra columnar piece.

Radial pieces, 1st series. Generally four in each ray, the first five (resting between the angular points of the subradials), are irregular in size and form, four are irregularly hexagonal, twice as wide as high, the fifth pentagonal and much smaller than either of the others. The second and third radials are obscurely hexagonal, similar in form, differing

* F. A. Roemer, N. Jahrbuch für Min., etc., 1850. p. 679, taf. vi, B.

† Zieler and Wirtgen Verhand. Nat. Hist. Verein der Preus. Rhinelande, &c. Bonn, 1855.

lightly in size: the fourth is axillary, obscurely six-sided, rising into a long angular point; on each of its oblique upper sides supporting three pieces of the secondary radials, which are similar in form and nearly as large as the first radials. The last of these being axillary support on their upper oblique margins each, from four to seven brachial pieces: these last are again axillary, and bear on one side a branch of from twenty-five to thirty pieces, on the other branch which is again divided on the sixth or seventh piece above the first division of the arms, each branch of this last division being composed of about twenty pieces.

Interradial fields, 1*st series.* These fields consist of about fifteen pieces each, the first of which rests upon the upper oblique margin of the first radial of the first series. Usually hexagonal, small, this supports two of the second row, similar in form and size; these last again support three of the third row, of the same form but a little larger; these again a fourth row differing slightly in form and size, which are followed by two superior rows of ten pieces each, of irregular forms, sometimes there is another at the summit of which completes the field.

Interradial fields of the 2nd series, five, composed of pieces similar in form, from six to seven in number, variously arranged, sometimes one surmounted by two similar pieces, these by two others, then a smaller one, or one at the base, with one above the other, these again by two ranges of two, then one, all these forms are occasionally found in the same specimen.

Interradial fields of the 3rd series. Usually ten, composed of from three to five pieces, not regular in form or arrangement, occasionally some of the fields are obscure or absent.

Anal pieces, six. The first is septagonal and rests upon the large subradial; upon it are two pieces, nearly similar in size; in the angle formed by their junction is one irregular shaped piece supporting two quite small quadrangular ones.

The arms are twenty in number, of irregular length, each branch divided into three fingers, making sixty in all: they are free from the third or fourth piece of the third division.

The arrangement of the several series of interradial fields between the branches of the arms produces a very large cup, in proportion to which the rays are quite short. The general form of our species is somewhat like that of *Icthyocrinus lævis*, (Conrad) Hall's figure, New York Geol. Rep., pl. 48, fig. 2. In the arrangement of the rays and the interradial fields in three series, it approaches *Forbesiocrinus Wortheni*, Hall (Iowa, pl. 17, fig. 5), from which it differs widely in the number of anal pieces.

Our specimens are nearly perfect, none of them exhibit the patelloid pieces of *F. Wortheni*, Hall. In several species of this genus which have come under our observation there are no patelloid pieces, in a few of our specimens (the prolongation of the superior pieces near the centre of their breadth overlapping the inferior) some of the prolongations are fractured, specimens of this character have probably led to the remark of Mr. Hall before cited. It is highly probable that this prolongation in the living animal was less calcareous than the remainder of the piece, and owing to this circumstance, was differently mineralized from the mass of the piece. This very difference in the composition of the pieces, supposing that the

prolongation was cartilaginous and the rest of the piece bony, would give flexibility to the body of the calyx and would have been especially useful to our similarly arranged species, whose rays are soldered together by the intercalation of three stories of intermedial and interbrachial fields.

Our figures are drawn the size of nature from the largest perfect specimen that has come under our notice, fragments have been found of larger individuals.

Geological position and locality. Rare in the beds of the subcarboniferous limestone near the top of the knob sandstone, Clear Creek, Hardin county, Ky. Also in the same beds in Washington and Montgomery counties, Ia. Vertical range unknown, it is probable that it is quite limited.

Forbesiocrinus ramulosus, sp. nobis.

Body discoid, rays long, prominent.

Basal pieces, three, of equal size, not projecting beyond the column, in perfect specimens appearing like the upper joint of the column; having an unequal thickness, the thickest part being in the centre of the width of the pieces.

Subradials, five, pentagonal, low, four times as broad as high. *Radial pieces*, the first are about twice as wide as high, obscurely quadrangular or pentagonal, lower margin convex, upper concave in the center, convex on the outer corners; the second and third are similar in size and form; the fourth are pentagonal, similar on their lower margins to the first, second and third, increasing in breadth at the centre where they terminate in an elevated point. The first and second radials join each other, the remainder do not touch at any point.

Secondary radials. The oblique upper margins of the fourth primary radials support each, two branches, varying from four tc six pieces (usually four). to the second bifurcation. In like manner the main divisions of the rays, ten in number, branch to the right and left alternately to the end of the main branches, making generally from 14 to 16 branches. These larger branches are subdivided from three to five times.

Anal pieces, usually from four to six. The first is the largest piece in the circle of subradial pieces, hexagonal; on its upper margin is placed a rectangular parallelogramic piece three times as high as wide, on this rests three or four small pieces one above the other.

Interradial pieces. Between each primary ray there is one, sometimes two, hexagonal pieces. It is not uncommon to find some of the rays without an interradial, in the young they are seldom present.

Interbrachials. Usually one between the main ray and the first divisions, sometimes these pieces are found between the main branches and the second, third and fourth divisions. In well preserved specimens the whole body and arms are covered with minute granules.

Column, round, diminishing from the body downwards, composed of very thin circular pieces, with a still thinner muscular (?) piece, separating them; a good lens is required to see this dividing member between the articulations of the column.

Dimensions of medium sized Adult:

Breadth of basal pieces, - - - - - -	·45	inch.
Height of subradials, - - - - - -	·20	"
Width of " - - - - - - - -	·45	"
Length of first 4 radials, - - - - -	·75	"
Length of arms, - - - - - - -	3·75	"

This crinoid is referred with some doubt to *Forbesiocrinus* of de Koninck as defined by Jas. Hall, Geol. of Iowa, part 2, p. 630. In technical strictness this is not *Forbesiocrinus*, and will not fall into that genus. This particular section of the crinoidea appears to have been a stumbling block to all palæontologists up to this time. The variety of opinions advanced, and the number of genera erected, to receive analogous forms has not diminished the difficulties pertaining to the subject.

Our species has from four to six anal pieces *and no more*, the generic definition requires ten to twenty-four or more; in our specimen the arms are ten, branching, having no tentaculæ, the generic definition requires forty to sixty. If the branches from the first bifurcation are taken as arms, ours instead of ten as we define it to have, has $10 \times 16 = 160$ arms. These differences should certainly be generic, yet the analogy of form is such that it is proposed to modify and extend the generic formula and admit this and other allied forms.

Geological position and locality. Subcarboniferous limestone, Hardin Co., Ky., and in similar rocks in Indiana.

ACTINOCRINUS. (Miller.)

Actinocrinus cornigerus, sp. nobis.

Body. General form subglobular, conical, below the arms having the form of an inverted cone which is about two-thirds the length of the entire body, the whole surface beautifully ornamented with carina, spines and tubercles.

Basal pieces, three, prominent, nearly equal in size, forming together a large irregular hexagon: each piece has a broad leaf-like expansion raised upon its outer margin, overlapping and partially concealing the sutures formed by their junction with the row of pieces following them. Opening pentaphyllous.

First radials, five, hexagonal, near the centre of each is a prominent tubercle from whence radiate six fasciculi of from two to six ribs each; these extend to the edges of the pieces where they are met by similar ones from the next piece, thus forming a series of triangular markings, the points of the triangles resting near the centre of each three adjacent pieces. The lateral markings surrounding the base are quite prominent and form around it a raised hexagon.

Second radials, five, hexagonal, a little smaller than the first radials and similarly ornamented.

Third radials, five, two of which are hexagonal, the others being pentagonal. The strong rib which proceeding from the centre of the first, and extending over the second radials, bifurcates near the centre of the third, giving off two ribs. From the upper margin of the third

radials rise two radials of the second series: on each of these the rib again bifurcates. Each of these last pieces bear two others; on those nearest each other the rib again bifurcates, each branch of the first bifurcation thus bearing three ribs, which are here joined to the free arms.

Interradial pieces. Generally from three to seven, they are disposed as follows: first, a large hexagonal one succeeded by two nearly equal to it in size, also hexagonal, then follow sometimes two, three or four, differing in form, these again are followed by a number of small hexagonal pieces.

Anal pieces, seven to sixteen; the first of the series is hexagonal, in the same circle with the first radials, equal to them in size and having the same ornament, this piece is followed by two others as in the interradial fields, except that the pieces are generally smaller. Upon these succeed four, sometimes more, which are followed by three regular and a cluster of four petal-like pieces with one to the right of the cluster completing the row. The ornature of all these pieces is the same as on those already mentioned, being quite as prominent on the small as on the large pieces, thereby causing an extraordinary rugosity on the smaller pieces.

Interbrachial pieces. In a line with each ray, interposed between the brachials, are two interbrachials, one immediately above the other.

Vault. The surface of the vault is thickly studded with granular markings except on the anal side. The summit frequently has a long spine, nearly central, from which proceed raised folds projecting toward the arms, terminating at a spine or circularly disposed group of pieces around a central one. A short distance within the circle of the arms, along the centre of the folds, the pieces are generally larger than on the interval between them, the tubercles are also much more prominent on these larger pieces. On the anal side the vault is more convex than on either of the other sides, it is covered by about twenty-five or thirty small polygonal pieces not ornamented like the other pieces composing the vault: near the centre of them is a cluster of nearly smooth pieces, six of them very minute and angular, surrounded by six larger angular pieces, making together a stellate figure of six points both falling into and nearly covering one of the hexagonal spaces composing this part of the vault.

Column, round, near the body composed of pieces alternately larger and smaller. Our species resembles most closely *A. costus*, (McCoy) both in its general form, size, disposition and ornature. The absence of a central proboscis, the difference of the basals, the garniture of the vault and the greater number of the arms, renders it an easy task to distinguish between them.

Geological position and locality. Found in great abundance at the quarries on Beargrass Creek, near Louisville, also at Rock Island, Falls of the Ohio. Very few perfect specimens have been obtained. The vertical range appears to be quite small having been procured only from a thin bed of limestone, seven feet thick, situated between the black slate and hydraulic limestone beds near the top of the Devonian rocks in the neighborhood of Louisville, Ky.

Actinocrinus, sp. nobis.

Body, uniform, symmetrical, enlarging rapidly beneath the arms, vault tumidly conical, centrally surmounted by a strong proboscis nearly as long as the height of the body. Base plain below, slightly excavated for the reception of a large column which is round, composed of alternately thick and thin pieces.

Basal pieces, hexagonal, thick, low, margin and angles rounded, slightly inflated, projecting beyond the column around which it forms a pitaliform border, perforation small, pentagonal.

First radials, hexagonal, much smaller than the basal pieces, on the upper margin of which they rest, prominently marked, transversely, by a long knob a little below the centre of the pieces.

Second radials, very small, subquadrangular, nearly as high as wide, inflated in the same manner as the first radials.

Third radials, much larger than the second, differing in size and form, obscure octagonal, septagonal and hexagonal, some higher than wide, others four times as wide as high: on their oblique upper margins they support a series of two secondary radials each, the second of which are axillary, supporting usually four brachials, three being subquadrangular, about four times as wide as high, the fourth obscurely pentagonal, bearing two long delicate arms composed of a double row of joints; the arms become free from the last brachial. The two postero-lateral rays have an additional arm on those branches joining the anal pieces. This gives each postero-lateral ray five arms, and four to each of the others, making in all twenty-two arms of two fingers each. These fingers are fringed with fine long cilia.

Interradial pieces. The first is large, (inferior in size to the first radials), hexagonal, ascending sides diverging, and resting in a deep angular notch between the first radials and similarly inflated; the oblique upper margins support each a piece of the second row, which differ much in their size and form, one in each field usually hexagonal, the other pentagonal, joined they present an angular notch between their summits in which rests one piece; sometimes another, quite small, is added.

Anal pieces. The first is septagonal, and is the largest piece, composing the circle about the basis; upon this rests three pentagonal, or obscurely hexagonal, pieces of the second range; by the same arrangement are added the third and fourth range, each range being composed of smaller pieces than the preceding one, sometimes a small lanceolate piece surmounts this pyramid completing it to the level of the arms. The first anal piece is marked like the first radials, the others are ornamented by a low, central tubercle.

Vault. The vault is covered by numerous polygonal pieces differing slightly in size, inflated, terminating in a point more or less sharp and round near the center of the pieces.

Proboscis. This like the vault is covered by polygonal pieces which differ remarkably in size, knobbed or spinigerous, the side corresponding to the anal side being covered by oblong pentagonal pieces some of which bear a range of two or three knobs or spines, on the opposite side the pieces are relatively much smaller, and the spines longer.

Dimensions of large Specimen.

Height of calyx, - - - - - - -	·95 inch.
" " vault, - - - - - -	·70 "
" " base, - - - - - - -	·20 "
Length of proboscis (not complete), - -	1·80 "
Height of calyx, vault and proboscis, - - -	3·20 "
Length of arms partly concealed, - - -	3·45 "

Geological position and locality. Imperfect, but recognizable, specimens occur at the quarries near Louisville and Nashville Railroad, Clear Creek, Hardin Co., Ky., associated with *Eretmocrinus magnificus*, &c. For the specimen figured we are indebted to the cabinet of O. A. Corey, Esq., who with praiseworthy liberality, placed at our disposal the whole of his splendid cabinet of crinoidea. *A. grandis* is nearly related to *A. turbinatus*, Hall (Iowa, p. 587, pl. ii, fig. 1), also to *A. longirostis* (Ib., pp. 589, 590), from both of these our species differs in the ornature of the pieces, the number of arms, and so far as may be determined, by the figure and descriptions referred to, by the pieces covering the proboscis and the vault, and the number of pieces composing the anal and interradial fields.

ACTINOCRINUS, Miller.

Sub-Genus, ERETMOCRINUS, Lyon and Casseday.

It is proposed to erect a sub-genus, *Eretmocrinus*, to receive a class of crinoids having the general arrangement of parts by which actinocrinus is recognized, yet differing so widely from that genus in the structure of the arms, the base, and the general appearance as to be instantly recognized. The structure of the arms differing so remarkably from all known genera, would at once suggest a difference of habit in the animal.

Generic Formula.

Basal pieces,	3, large and extending beyond the calyx.
Radial "	3×5, very small.
Brachial "	3×26.
Interradial "	2×4, one larger and one smaller.
Anal "	6×8.
Interaxillaries,	0.
Proboscidiferous.	

Arms, 26, long paddle shaped, deeply grooved on the inner face, fimbriated on both sides of the groove.

The generic name was suggested by the oar-like arms of this splendid crinoid.

Eretmocrinus magnificus, sp. nobis.

The general form of the body is that of a double cone, the point of the inferior cone truncated and one third shorter than the upper one, which is prolonged by a proboscis or oval tube; the whole body rugose and below the arms covered by minute granular markings.

Basal pieces three, large, nearly equal in size, forming together a basis resembling a thick button, the margins projecting a considerable distance beyond the body where it joins to it, deeply concave below, the depression left by the column forming a still deeper concavity, occupying about half the diameter of the whole base, the centre being perforated by a small pentapetalous opening.

First radials five, very minute, quadrangular, thrice as wide as high.

Second radials similar in form and size to the first radials. The third radials are axillary, twice the size of the first, and support on each bevilled edge two pentagonal secondary radials, the last of which are again axillary, giving off two rows of three pieces each to the free arms, except in the postero-lateral rays, where the third secondary radial becomes again axillary and supports on each bevilled edge two rows of three pieces which reach to the free arms; the postero-lateral rays supporting five arms each, the others only four. The brachials are considerably broader than long, and so arranged that the salient angle of one piece fits into the retreating angle formed by the two pieces opposite it. Commencing at the junction of the base with the first radials rises a row of single carinated protuberances, more or less prominent, extending from the base along the middle of the rays and their branches to the free arms distinctly marking the course of the rays.

Interradials usually two, a large hexagonal one followed by a smaller one of similar form.

Anal pieces six, the inferior three are pentagonal, their inferior and lateral margins nearly equal, the lines defining the upper are shorter and produce a sharp angular point at the summit of the pieces: between these angular points of the first range, rest two hexagonal pieces a little inferior in size to the first; upon these last rests a hexagonal piece still less than those of the second range. The surface of the anal and interradial pieces are plain surfaces, except the fine granular markings before described.

Vault. The vault is of an elevated conical form surmounted by a proboscis, the whole being covered by irregular sized pieces, generally hexagonal in form, rising from the margins toward the centre and terminating in a point—in some specimens, the centre of the pieces are marked by two or sometimes three points. It happens that all these forms are found in the same specimen.

Arms. The arms of this splendid crinoid are so unlike anything before described as to merit special attention. They are (on medium sized specimens), about four inches in length. They rise from the calyx in a sub-rotund column about one third of their length, when they flatten and expand towards the top: at the middle of their length they are half an inch wide and about a sixteenth of an inch thick, for a short distance the margins are parallel when they suddenly contract by a graceful curve to about half their greatest width, the sides again becoming parallel for half an inch, when they close by a circular curve which bounds the upper extremity. The insides of the lower parts of these arms are flattened and grooved by a deep semicircular sulculus, the margins of which are lined with very fine, long cilia up to the enlargement of the arms, beyond which they cannot be traced, in fact we suppose

they extend only so far. The body of the arm is composed of a double row of pieces, very small below, increasing in size upward; where the arms are most expanded they number about twenty-four to the inch, in the lowest part from thirty-six to thirty-eight to the inch.

Geological position and locality. Found in vast numbers in the quarries near the Louisville and Nashville Rail Road, Clear Creek, Hardin Co. Kentucky, at numerous localities in Indiana, in beds near the top of the Knob member of the sub-carboniferous rocks. On Clear Creek the horizon of our species is 180 feet below the equivalent of the *Batocrinus* and fish beds of Spurgen Hill, Indiana. The arms, and in the absence of these, the general form, especially the button-like projecting base, distinguish this from *Actinocrinus.*

Dimensions of medium sized specimen.

Height from base to foot of proboscis,	1·45	inch.
Height of calyx to free arms,	·45	"
Diameter at free arms,	1·7	"
" " base,	·50	"
" of "	·65	"
Height of base,	·10	"

Megistocrinus, Owen and Shumard.

Megistocrinus rugosus, sp. nobis.

Body subglobose, truncated; below the truncation concave: from the second radials to the summit it is subcylindrical, thence assuming an unsymetrical, subconoidal form; surmounted by a long proboscis. The pieces of the calyx being ornamented with very prominent angular tubercles, give it an exceedingly rugose appearance, hence its specific name.

Column round, composed of alternate thicker and thinner pieces, the thinner ones being broader than the others.

Articulating surfaces marked by very short striæ confined to the outer margin, canal pentapetalous.

Basal pieces, three, forming together an irregular hexagon, the longest diameter of which is parallel to the anal side. The first facet of the column covers nearly four-fifths of the base: outside of this facet, these edges are finely granulated.

First radials, five, forming together with the first anal piece a circle of very symmetrical hexagonal pieces. Their surfaces are beautifully ornamented with striæ disposed hexagonally and interspersed with granular markings.

Second radials, five, also hexagonal through not so regular in form as the preceding ones. That portion of their surface lying nearest to the first radials is generally ornamented with fine granular markings, whilst the portion joining the third radials is strongly tuberculated, this peculiarity together with the comparatively smooth surfaces of the basal pieces, first and second radials, and the intervening interradials, forms a striking contrast with the rough sides and prominent thorns of the upper surface of our species.

Third radials, five, generally irregularly hexagonal, thick, tuberculated, axillary, and support each two brachials. In three of the rays they are axillary, and support on each facet one or two pieces, from which proceed the free arms, each ray thus supporting four arms. In the two remaining rays they are also axillary and support one or two pieces each, the ray having only one pair of arms, thus making in all sixteen arms. This disposition of the number of arms in a ray is constant and characteristic.

Interradials. These vary in adult specimens from thirteen to fifteen, in younger ones we generally find seven or eight. The first three or four pieces of the interradial fields are hexagonal. Situated between the radials, which they resemble in size, form and ornament, the remaining pieces of these fields become gradually smaller, and are less regular in their form and disposition. All of these as well as the other pieces forming the sides of the calyx are very thick, and ornamented by prominent arm bones, or boss-like projections. They are joined together only at their lower edges, the upper portion of each piece being free and separated from the contiguous one by deep sulculi.

Anal pieces, fifteen to twenty-five, varying with the age of the specimen; presenting much the same character as the interradials just mentioned. The one resting on the base is equal in size to the first radials which it resembles, this is succeeded by three large hexagonal pieces, nearly in a line with the second radials, the remainder are smaller and irregularly disposed.

Interbrachials. Between the brachials, and in a line with the radials, are interbrachial pieces, one large and two smaller pieces. In the second bifurcation, in those rays having four arms, and between the last brachials, there is generally one other interbrachial interposed, sometimes two or three. The arms are sixteen in number running off in two pairs of two, and three sets of four.

Vault. The vault is covered by small polygonal pieces arranged in clusters of seven to ten about a central one, which is usually larger than the surrounding pieces, and usually spinigerous. With the exception of the spines, the vault is devoid of ornament. The pieces are raised in the centre giving this part a varicose appearance. The proboscis is long, subcentral, composed of pieces similar to those of the vault; at or near the base of it is a spine which is nearly central, or somewhat larger than any other spine upon the summit.

Geological position and locality. This magnificent crinoid is found in considerable numbers in rocks of the Devonian period, a few feet beneath the black slate, at the quarries on Bear grass Creek near Louisville, Ky. We have referred this fossil to the genus *megistocrinus*, which it resembles so closely in the number and arrangement of the pieces that such disposition of it will hardly be questioned. It is found in the Devonian rocks of the age of the Hamilton group, associated with *Orthis suborbicularis*, *Atrypa reticularis*, *A. aspera*, *Euomphalus cyclostomus?* &c. This is about the same horizon in which Hall found his *Megistocrinus latus*. A fossil closely allied to this is found in the Devonian rocks of Spain, and described by De Verneuil as *Pradocrinus Baylii*,* a second species *P. Americanus*, is found on the Falls of the Ohio.

* Bulletin de la Geol. Soc. de France, 2d Series, t. vii, p. 187, pl. 2, fig. 11.

CYATHOCRINUS, Miller.

Cyathocrinus multibrachiatus, sp. nobis.

Calyx, vasiform, the pieces thick and tumid, surface ornamented with confluent granulose markings. Column, round, proportionally small.

Basals, five, pentagonal rather large; their under surfaces are scooped out forming a patelloid excavation which is entirely overspread by the column. Their superior margins are prolonged into angles.

Subradials, five, fitting into the retreating angles of the basis, four of them are hexagonal, the fifth, the anal piece, is heptagonal. Of these pieces the two postero-lateral ones are larger than the two antero-lateral one; the anal piece is yet larger and longer than any of the remainder. From the prominent centre of each piece, broad plications, vaguely marked proceed to the margins.

First radials, five, generally pentagonal, their width double their height, ornature same as on the other pieces, their upper edges are bevilled, near the centre of each of these edges is a cicatrix bounded by a strong thick margin, which occupies from one-third to one-half of the width of the piece, these support the remaining radial pieces which vary in different rays from two to seven in number, they are very irregular in size though usually wider than high.

Anal pieces, two, the first is obscurely heptagonal, larger than any of the other pieces of the calyx, succeeded by a small parallelogramic piece which forms the basis of the proboscis.

Vault. The form of the pieces composing the vault is unknown. The proboscis is excentric, occupies about one-third of the whole summit and is composed of small irregular hexagonal pieces whose surfaces are thickly studded with fine granulæ. Its length equals the height of the calyx.

Arms. From the last radial pieces of each ray there extend laterally two strong branches, each of which give off five or six smaller ones, these become subdivided and decrease regularly in size as they proceed from the axillary radials: this arrangement can be perceived only when portions of the arms have been removed, as they interlace and overlap each other. The pieces composing the arms have a parallelogramic form, their places of articulation marked by an elevated rim, surfaces otherwise perfectly smooth. We may readily suppose that at their final development the arms number from one hundred to one hundred and twenty.

Our specimen resembles *Cyathocrinus intermedius* of Hall (Iowa, p. 627, pl. 18, fig. 10), yet the differences are so marked that they will be easily distinguished.

Position and locality. Found in the subcarboniferous beds of Montgomery Co., Indiana, associated with *Forbesiocrinus*, *Platycrinus*, *Goniasteroidocrinus* and other crinoidal remains similar to those of the Keokuck limestone of Iowa.

Cyathocrinus multibrachiatus, var.

The basal, subradial, radial and anal pieces have the same form, relative size and position as in *C. multibrachiatus*. In the specimen figured the surfaces of all the pieces forming the calyx are destitute of any markings, wanting entirely the plications and granular ornature found on the

species above referred to; although this is true of another specimen in our collection, we suppose it owing to the imperfect conservation of those particular specimens rather than a constant characteristic of the variety. The principal differences are in the arms and the proboscis. The pieces composing the proboscis of the variety are arranged in parallel rows instead of alternating with each other as they do in *C. multibrachiatus.* The arms of the variety come off as in the species, namely, the last radial piece which is axillary, supports two rays of arms, but the secondary branches such as noticed in the description of the species continue in most instances throughout their whole length without bifurcations. This arrangement will be easily understood by reference to plate 5,* fig. *b*, 1, 2.

Position and locality. This crinoid occurs in the same beds as its congener described above.

Art. XXX.—*Contributions to Mineralogy;* by Fredk. A. Genth.

1. *Native Iron.*

About four years ago I received for examination a mineral, which was said to be found in the neighborhood of Knoxville, Tennessee, in considerable quantities, and which was believed to be a valuable nickel ore. A qualitative analysis of it, made at that time, proved it to be almost pure iron, and the total absence of carbon, phosphorus and sulphur, and its peculiar appearance, made it very probable that it was *real native iron.* The specimen, which I received was $1\frac{1}{2}\times1\frac{1}{2}$ in size, on one side of it the iron was $\frac{1}{4}$th, on the other $\frac{1}{8}$th of an inch in thickness; on one side it was incrusted by a silicate of iron, magnesia and lime.

The iron itself is of a greyish white color, a hackly fracture, and breaks easily into fragments of an irregular shape, which are crystalline, without, however, showing signs of any distinct planes. It is soft and scratches fluorspar with difficulty. Lustre eminently metalic. Dissolves readily in nitric acid. It was found to contain:

Iron,	99·790
Nickel, with a trace of Cobalt,	·140
Magnesium,	0·022
Calcium,	0·121
Silicium,	0·075
	100·148

About a year after I had examined the mineral from Knoxville, I received the *same* substance from northern Alabama as an alloy of gold, platinum, silver, copper, etc., with the request to advise a plan for the separation of these metals.

I have endeavored to obtain more of this interesting substance from both localities, but the parties, probably not being satisfied

* To be given hereafter.

with the results of my examinations, did not comply with my request, and I hope others may be more successful than I have been.

2. *Native Bismuth.*

A fragment of the beautiful variety of Bismuth from the Peak of the Sorato, in Bolivia, S. A., where it occurs in masses of a broadly laminated structure, the foliæ frequently interlaminated with films of native gold, has been presented to me by Chas. M. Wheatley, Esq., and was found to contain:

Bismuth,	99·914
Tellurium,	0·042
Iron,	*trace*
	99·956

3. *Whitneyite.* Am. Journ. Sci., [2], xxvii, 400.

In his Report on Lake Superior, Washington, 1849, p. 447, Dr. C. T. Jackson makes the following observations. "Aug. 3d, 1848. Crossing over the summit of the cliff and descending a few rods on the slope, we came to a little vein, which was supposed to be antimonial copper ore, but which, by blowpipe analysis, gave only arsenic and copper." This passage having escaped my notice at the time of writing my paper, I have not done Dr. Jackson full justice before. It is very probable that Dr. Jackson had my new species (Whitneyite) in his hands as early as Aug. 3d, 1848, (although he having failed to give an analysis of the same, there is no positive evidence of it). It is certain that he had a mineral, in which by blowpipe tests he found *only* arsenic and copper; but he does not express his opinion about it or its claims as a mineralogical species—and therefore, if he has been aware of the true nature of this interesting mineral, he has done an injustice to himself and science by not publishing his views about it.

So learned an investigator as Dr. Jackson could not have been ignorant that it was Domeyko, who first in 1843, described and analyzed the mineral which bears his name and proved the existence of arsenids of copper in nature which had not been recognized by Faraday, and von Kobell by their analyses of the same mineral in its impure and partly oxydized state of condurrite.

It is by no means certain, however, that the mineral noticed by Dr. Jackson, in 1848, was not the arsenid of nickel and copper noticed in this Journal, [2], xix, 417, by T. S. Hunt, and again on p. 15, this vol., by Prof. Whitney.

4. *Barnhardtite.*

This species, of which Breithaupt under the name of Homichlin gives a great many localities, promised, when first observed, to become a very important copper ore of North Carolina; it

has, however, not been observed since in its *pure state.* The localities Phœnix and Vanderburgh mines, mentioned by Otto Dieffenbach, are extremely doubtful, the specimens, which came to my notice from there, were only tarnished chalcopyrite; the Barnhardt mine has proved to be worthless, and is exhausted, whilst the ores from the Pioneer Mills mine, which I have from time to time obtained, were mostly the mineral mentioned in my paper, Am. Jour. Sci. [2], xix, 18, as containing about 40 p. c. of copper, or mixtures of chalcopyrite and barnhardtite with copperglance, which latter could be easily distinguished with a good magnifier in small veins, running through the whole mass, whilst the barnhardtite, previously examined, was quite homogeneous. The mixtures of copperglance with barnhardtite and chalcopyrite, as well as the barnhardtite itself, are interesting results of a peculiar decomposition of chalcopyrite, in which two equivalents of the latter are in action, and after the oxydation of the sesquisulphid of iron of one equivalent, the subsulphid of copper, thus liberated, combined with the other equivalent of chalcopyrite. This oxydation of the sulphid of iron in copper ores and concentration of the copper, resulting from the same, bears an analogy with the peculiar roasting process at the Austrian copper work at Agordo, where an iron pyrites, containing about 2 p. c. of copper, is roasted in lumps of the size of a fist; the copper concentrates in the centre, forming compounds similar to the above mentioned 40 oz. copper ore, barnhardite and erubesite, whilst the crust is chiefly composed of sesquioxyd of iron.

5. *Gersdorffite.*

I have observed this mineral on a specimen of anglesite from Phœnixville, Pa., on which it forms an incrustation upon partially decomposed galena and zincblende, associated with quartz, chalcopyrite and covelline. The very small crystals are cubes with octahedral planes and, very rarely, those of the pentagonal dodecahedron, the latter frequently indicated by the striation of the cubical planes. B.B. it gave the reactions of sulphur, arsenic and cobalt; a nitric acid solution, however, showed the presence of a larger percentage of nickel than cobalt.

6. *Molybdate of Iron.*

I am indebted to Dr. D. D. Owen for some fragments of this mineral from Nevada City, California, and have made a few experiments with the same, but regret that the rarity of this substance prevented a fuller examination. That which could be scratched off the quartz was not quite pure and contained a trace of limonite. Dilute ammonia acted readily upon it and extracted *all* the molybdic acid, leaving behind the hydrated sesquioxyd of iron of a brown color. The sample examined gave 24·3 p. c.

sesquioxyd of iron, some of which was *certainly* mechanically xed with it. Dr. Owen found by his experiments 35 p. c. of quioxyd of iron—from which it appears that this substance ists in the mineral in variable quantities. This fact and the ier that dilute ammonia extracts the molybdic acid easily and mpletely, leave very little doubt that the Nevada City mineral a mechanical mixture of molybdine with limonite, although I ll admit that no *positive* opinion can be formed about it, unless ger quantities of the pure mineral are subjected to repeated alyses.

7. *Albite.*

a. In a lot of gold ores from California, which were sent to me examination, I found a peculiar variety from the metamoric slates of Calaveras county, consisting of a granular variety albite, calcite, quartz and a talcose or chloritic mineral, mixed th auriferous pyrites and frequently with visible gold, and rked at Angel's, Major Fritz's, Dr. Hill's and Winter's mines. e albite showed sometimes a sublaminated and somewhat ergent structure, but only, where calcite predominated and uld be removed by acid, crystals could be obtained. They re small and indistinct, showed however the common form or ins of the same. The following planes are noticed: *I*, *I'*, 1', *O* and *i i*. I analyzed a specimen of the granular variety, ed from calcite by dilute chlorhydric acid, and found:

		By J. L. Smith's method.
Silicic acid,	68·39	....
Alumina,	19·65	....
Sesquioxyd of iron,	0·41	....
Lime,	0·47	....
Soda,	10·97	10·58
Potash,	*trace*	*trace*
Ignition,	0·21	....
	100·10	

b. A massive greyish white variety of albite, much resembling trosilex and some kinds of jasper, from the Steele mine, Montmery county, N. C., has been examined in my laboratory by r. J. P. Pöpplein, who found it to contain:

Silicic acid,	60·29
Alumina,	19·66
Sesquioxyd of iron,	4·63
Oxyd of manganese,	*trace*
Magnesia,	0·23
Lime,	1·83
Soda,	9·90
Potash,	1·71
Water,	1·20
	99·45

For the determination of the alkalies, the albite, both from the eele mine and California, were decomposed by fluohydric acid.

Although the material for this analysis appeared to be quite pure and homogeneous, the already commenced alteration of this mineral is indicated by the low percentage of silicic acid, the presence of water, etc.

It is rarely associated with crystals of albite, but frequently with minute crystals of orthoclase, sphene, ripidolite, gold, pyrites, blende, chalcopyrite and galena.

8. *Ripidolite.*

The most interesting associate of the massive albite from the Steele mine is ripidolite, because it is the result of its alteration, as can be easily observed from the fact that, wherever the albite has a crack, through which water could penetrate more readily, a greenish line makes its appearance, which indicates the commencing change; where this has already made more progrsss, it can be seen that the ripidolite is lining both sides of the fissures, whence it frequently extends through larger masses, which are not rarely completely converted into it, but sometimes contain a nucleus of albite, often having the diminutive shape of the original piece.

In cavities it is rarely observed in wormlike aggregations of microscopic crystals, sometimes in peculiar casts,* having the appearance of crystals, but generally in masses of aggregated scales of a dark olive green color.

* Prof. J. D. Dana, who had the kindness to examine these casts, makes the following remarks in a letter, dated New Haven, June 28, 1859:

"I doubt their being pseudomorphs for the following reasons:

1. The even manner, in which they are often cut through, and the variety of directions, looking as if the cuts were due to crystalline plates that have been removed;

2. The fact that the cuts sometimes go only half way through the pseudo-crystals;

3. The irregularity of form presented; for although the surfaces are flat, there is no symmetry in the arrangement of the planes.

4. The surfaces large and small in nearly all cases are marked with equilateral triangles; while if they were true pseudomorphs, retaining the markings of the original crystal, they would be confined to planes of one kind; that is, if rectangular prisms, they might possibly occur in one pair of the faces, but would not also on the others at the same time, and much less would they be found on the planes replacing the angle. Moreover such regular triangles look as if the system of crystallization was rhombohedral or monometric, while the forms are very far from either.

5. In the largest pseudo-crystal there is a piece of the rock projecting on one side. Now this projecting piece has its margin for a breadth of nearly a line smoothly flattened into the same plane with the face of the crystal,—seeming to show that both the face of the crystal and this flattened surface of the rock were made by pressure against a flat surface of another crystal. Such triangles on all the faces, in connection with the other particulars mentioned, appear to me to show that there must have been originally intersecting crystalline plates with angular cavities between, and that the ripidolite occupies these cavities; if such plates were triangularly marked they would have impressed the triangles alike on all the faces of the ripidolite, filling the cavities. The difficulty in this view of the case is this— that such triangles do not occur on any mineral that I can suggest as the probable cause. They are found on some foliated chlorite, ripidolite, clinochlore and pyrosclerite, but what else?

I confess that I do not fully understand the ripidolite."

I found the pure mineral to contain:

Silicic acid,	24·90	contains	12·93	oxygen	= 1·20
Alumina,	21·77	"	10·17	11·55	1·08
Sesquioxyd of iron,	4·60	"	1·38		
Oxyd of iron,	24·21	"	5·37	10·74	1·
Oxyd of manganese,	1·15	"	0·26		
Magnesia,	12·78	"	5·11		
Water,	10·59	"	9·41		0·87

The oxygen ratio of $RO : R_2O_3 : SiO_3 : HO$ being 1 : 1·08 : 1·20 : 0·87, the ratio of the aivalents would be =12 : 4 : 5 : 10, and considering umina and sesquioxyd of iron as replacing silicic acid the mula $= 3\dot{R}_4\left(\begin{smallmatrix}\dddot{Si}\\ \ddot{R}\end{smallmatrix}\right)_3 + 10\dot{H}$, or perhaps better $= \dot{R}_6\left(\begin{smallmatrix}\dddot{Si}\\ \ddot{R}\end{smallmatrix}\right)_3 + 8\dot{H}$.

9. *Pholerite.*

A mineral has been observed in several of the coal mines of huylkill county, Pa., under similar circumstances to those, der which pholerite has been found in France and Belgium, it, their physical properties being the same, I consider them ntical, notwithstanding the differences between my own and illemin's analyses.

At Tamaqua it is found in scales of a yellowish white color, iich, however, can be easily removed by dilute chlorhydric d, and near Pottsville in snow white nacreous scales of a irly lustre.

Under the microscope the scales appear to be clinorhombic h the planes $\check{i}\check{i}$ predominating and $-1\check{i}$ indicated by the trunion of the acute basal edge of the right rhomboidal prism.

I have made several analyses of the mineral from Tamaqua, h in its original state and after purifications by dilute chlordric acid.

The analyses were made by fusion with carbonate of soda, as ll as with concentrated sulphuric acid; the silicic acid separal by the latter method dissolved completely in boiling carbon- of soda. The alkalies were determined by J. Lawrence ith's method:

	I.	II.	III.	IV.
	Original Mineral.	Extracted by Chlorhydric Acid.		Calculated.
	By NaO. CO_2	By NaO CO_2	By HO SO_3	$\ddot{A}l_3\,\dddot{Si}_4 + 6\dot{H}$
Silicic acid,	= 46·93	46 98	46 81	47·06
Alumina,	37·90	39·65	39 56	39 20
Sesquioxyd of iron,	0 18	——	——	——
Lime,	0·93	——	——	——
Soda,	Not determined.	0·11	0·11	——
Potash,		0 06	0 06	——
Water,	13 98	13·69	13 91	13·71
	99·92	100 49	100 45	100·00

These analyses show that many of the varieties of the so-called olin belong to pholerite.

10. *Scheelite.*

I have observed in North Carolina several new localities of this mineral.

a. At the so-called Dutchmen Vein of the Bangle mine property, Cabarras county, it has been met with between 90 and 100 feet depth, associated with pyrites and chalcopyrite in quartz; forming an ore, which contains from 2 to 3 ounces of fine gold in 2000 pounds. Although it is considerably disseminated through the whole mass of ore in fine grains, the largest masses, which I have seen were not over $\frac{3}{4}$ths of an inch in diameter.

No crystals have been noticed, but only granular masses of a pale yellowish brown color, distinctly showing the octahedral cleavage. It contains:

Binoxyd of tin,	0·13
Tungstic acid,	79·52
Oxyd of copper,	0·08
Sesquioxyd of iron,	0·18
Lime,	19·31
	99·22

b. Another locality is at the Flowe mine, Mecklenburgh county, N. C., where it is associated with barytes, chalybite, pyrites, chalcopyrite, wolfram and rhombic tungstate of lime.

Not more than two crystals have been observed; the first being a modification of the octahedron 1, slightly truncated by 1*i*. It has a yellowish brown color and would, if perfect, have a length of $\frac{3}{16}$ of one inch; the other crystal was about half that size, had a fine orange color and was a combination of the planes $\frac{1}{2}$ and *ii*; it contained a small quantity of *tungstate of baryta.* Both crystals gave B.B. traces of tin.

11. *Rhombic Tungstate of Lime.*

Found also at the Flowe Mine.

It has a yellowish and greyish white color, and a vitreous lustre, which is subadamantine on a fresh fracture.

The crystals are small and indistinct, an aggregation of many individuals frequently formed into one crystal; the largest one, which I have seen, but which was very imperfect, was $\frac{1}{4}$th of an inch long. All crystals contain a nucleus of wolfram. I have noticed the following planes: I, $i\bar{i}$, $\frac{1}{2}\bar{i}$, 1 and $1\breve{i}$; cleavage could not be observed.

Are these crystals pseudomorphs? I do not believe it, at any rate, they have not the appearance of pseudomorphs. We know that lime is isomorphous with oxyd of iron and manganese, I would therefore suggest that tungstate of lime is *dimorphous*, and that in this case it is coating a nucleus of $\left(\begin{matrix}Fe\\Mn\end{matrix}\right)O, WO_3$, just like a chrome-alum crystal, when placed into a solution of alum,

deposites upon itself a coating of the latter, or in the same manner, in which the green tourmaline, of Chesterfield, Mass., surrounds a nucleus of the red. I do not think that ever anybody considered the green a pseudomorph of the red one?

12. *Wolfram.*

I have examined the wolfram, which forms the nucleus of the rhombic tungstate of lime.

Only one crystal has been observed yet, which shows the planes *I*, *ĭi*, ½*ĭ* and 1*ĭ*. Sp. grav. at 25° Cels. = 7·496. It contains:

Tungstic acid,	75·79
Oxyd of iron,	19·80
Oxyd of manganese,	5·35
Lime,	0·32
Binoxyd of tin,	trace
	101·26

This corresponds with the formula: $4FeO, WO_3 + MnO, WO_3$.

13. *A few observations on the occurrence of Gold.*

Much has been said and written about the occurrence of gold in veins and elsewhere and the formation of the same, but comparing the different theories with some very important facts, we are often at a loss to explain the latter satisfactorily, and it seems to me that we know but very little about this difficult subject. Without any intention to discuss the merits of the different theories, I will give in the following a few data, which may help to throw some light on this question.

Gold is frequently found in diorite (in smaller quantities in syenite and granite) and although it is only rarely observed in the massive rocks, I have seen specimens from Honduras, C. A., where it was imbedded in the diorite without any other association. The result of the complete decomposition of the diorite is generally a red clayish soil and this has in the gold region of North Carolina, etc., a high reputation for its richness in gold. It was in the diorite region of Cabarrus County, N. C., where the first large piece of gold was found, weighing twenty-eight pounds. All this soil is more or less auriferous, but containing the gold somewhat concentrated, nearly in the same ratio, in which the lighter particles have been washed away. But not only in this country the diorite has been found to be auriferous, as is proved by the large piece of eighty-six pounds which was found at Alexandrowsk near Miask in Siberia, nine feet below the surface, in diorite.

The gold obtained from the disintegrated diorite is generally smooth and rounded as if it was water-worn. This cannot be, however, because it lies still in its original, but only altered matrix, and has not been subjected to any attrition by water and

sand; besides, if we observe any cavities in such gold, we find the sharp edges of crystals, etc., in the same, rounded in a similar manner, just as if the whole piece had been subjected to the action of acids, which in reality seems to have been the case. I believe that this is the most natural explanation, because it tells us at the same time, to what source we must trace the gold, which we find in the veins passing through these formations.

The greatest difficulty presents itself by inquiring into the nature of the solvent. I do not believe it is very probable that the gold has been carried off as a silicate of gold, or by the action of chlorhydric acid upon the sulphid. What seems to me most reasonable, is that it was dissolved as terchlorid of gold. If we remember, that the decomposition of pyrites, one of the most common accessory constituents of diorite, produces sulphuric acid, which in the presence of the never wanting chlorid of sodium and an higher oxyd of manganese may liberate small quantities of chlorine, the most powerful solvent of gold, we have at least a very plausible explanation.

After penetrating the decomposed diorite the solution of gold, passing down the veins, comes in contact with reducing agents and is reprecipitated again, frequently in crystals or crystalline forms. I shall farther below make a few remarks about the substances which precipitate the gold, in veins as well as in beds.

An almost positive proof that the gold in the veins of the diorite formation originates from the adjoining rocks is the fact that the deeper the diorite is decomposed, the deeper the gold is found in the veins. Many of these veins do not contain any gold at fifty feet depth, and I have known veins, which were rich near the surface, not to contain a trace of gold at thirty-five feet depth. Very few of these veins (if not on high hills) carry any gold below 120 feet depth.

The occurrence of gold in beds in the metamorphic slates at great depth can far more be relied upon; Gold Hill, in Rowan Co. N. C., for instance, is over 600 feet deep and the ore as rich as ever. Although it cannot be denied that the greater portion of the gold in such deposits is as old as the stratum itself, in which it occurs, it is certain that inside of such auriferous strata constant changes are going on, gold dissolved and reprecipitated. We could not account for the crystalline structure of most of the gold in such beds if we would not presume that the freshly precipitated gold deposits frequently *upon* that already present.

The description of a few specimens in my collection may be interesting, for they prove that the gold *must* have been in solution.

a. From Whitehall, Spotsylvania Co. Va.,—shows gold associated with tetradymite, limonite and quartz. The gold is crystallized in forms belonging to the rhombohedral system and

g very distinctly one rhombohedron, scalenohedron and lan; it is coating tetradymite and evidently a pseudo- after it. I have seen other specimens from the same , but of inferior value and beauty.

ie tetradymite from the Tellurium Mine, Fluvanna Co. id the native bismuth from the Peak of the Sorato in , S. A., are frequently interlaminated with gold.

re made some experiments with a solution of terchlorid and tetradymite and found that the latter precipitates d from a dilute solution easily with a smooth and brilliant

the upper portion of the ore bed in the metamorphic it Springfield, Carroll county, Md., which, near the sur- nsists of magnetite and at a greater depth of chalcopyrite ier ores, sometimes films of native gold have been ob- coating the cleavage planes of magnetite. On close ex- on it can be noticed that below the film of gold the mag- s oxydized into hydrated sesquioxyd of iron.

very striking occurrence of native gold is, that where it iated with pyrites. Most of the pyritous gold ores are too form a positive opinion about the form, in which they the gold, from observation, and many authors are of that the gold may exist in the form of a sulphid, either f or as a sulphosalt. If we take it for granted that the itself is the result of the reduction of iron-salts and bear l that protosalts of iron reduce gold *instantaneously*, we adopt this opinion. But even if terchlorid of gold should been precipitated by sulphydric acid, whilst passing the vein, it could not remain in that state for a long ecause moist tersulphid of gold in the presence of the t trace of an acid is easily decomposed into metallic gold phuric acid. Some specimens of auriferous albite from 's vein, Calaveras county, California, show beautifully herever there is a crystal of pyrites, small crystals of gold ched to it, demonstrating, that the sulphate of iron pre- d the gold, previous to its own reduction into pyrites.

hese facts prove that the gold is carried into the veins e adjoining rocks, and that the opinion, which considers ie source of the gold of alluvial and diluvial deposits and , is erroneous.

iother proof was wanted to show the fallacy of this idea, d be the fact that the gold from the soil or alluvial and l deposits, has rarely the same fineness as that from the rought in the immediate neighborhood of the same, the eing generally less fine. It is impossible therefore that truction of a portion of these veins could have furnished d of such deposits.

elphia, July 27, 1859.

ART. XXXI.—*Notice of a Memoir by M. Jules Marcou, entitled "Dyas and Trias or the New Red Sandstone in Europe, North America and India."** (In a letter from Sir RODERICK I. MURCHISON to the Editors.)

Gentlemen—

IN the early part of last winter I read with surprise the following paragraph in a published letter by M. Jules Marcou on American Geology. "I think that the term Permian, at least as given by Murchison for the strata of the government of Perm, a very improper one. There are strong suspicions that Murchison has put into his Permian a part if not the whole of the Trias, and I am almost certain that if geologists accept the Russian Permian as Murchison has defined it as the type, the Trias will disappear from classification in Asia, Africa, America, and Australia."

Considering this to be a serious charge, I wrote to M. Marcou and begged to know the grounds on which he had made it. As he had never been in Russia, I called his notice to another expression in his own letter on American geology in which he says: "not having visited Kansas or Nebraska I have no decided opinion respecting the geology of those countries; for I profess the doctrine that geologists must see with their own eyes," &c. I further expressed a wish, that M. Marcou had acted on his own doctrine, as respected Russia, before he passed so severe a judgment on the researches of M. de Verneuil, Count Keyserling and myself. The replies sent to me by that gentleman, though very polite, being by no means satisfactory, I stated to him my intention of publishing our correspondence in your journal. But I abstained to do so until M. Marcou had produced a fuller explanation of his views.

After a study of the original work of my friends and self, M. Marcou has at length produced his results in the Bibliothèque Universelle de Genève under the title of which a translation is given at the head of this letter.

Leaving my able contemporaries in America and the Geological Surveyors in India to settle their accounts with M. Marcou, I have requested my coadjutor, M. de Verneuil, to answer this article in the French language. In the mean time I confidently refer the judgment of the value of this critical essay to all geologists who have followed the progress of their science.

All such persons know, and particularly those who have read the new edition of my work on Siluria, that the absolute distinction between the fossils of the Permian group or *Dyas* of M. Marcou and those of the Trias is much more sharply defined

* Bibliothèque Universelle de Genève, Mai et Juin, 1859.

than ever, and yet he reverts to the former and obsolete state of the science and merges these two most markedly separated deposits in one natural group. The author applies his new word 'Dyas' to the rocks in question because the two deposits only of Rothe-liegende and Zechstein chiefly prevail in certain tracts; but geologists who have gone through all the proofs I have adduced from various countries of a clear division of the Permian rocks into three parts, of which Zechstein is the centre, will not easily be led to adopt the use of the new word—still less to mix up as proposed the Dyas and Trias in one geological group.

Although I will not answer objections in detail on the geology of Russia which proceed from a writer who has never been in that country, let me inform those of your readers who are in the same condition as M. Marcou, that one of the very reasons he assigns to depreciate the correctness of my ultimate classification, ought to operate in my favor. It is quite true that in most parts of the vast region of Russia (larger than France) occupied by the rocks to which I assigned the name of Permian, there is no large development at their base, of those deposits which in Germany are known as the Roth-todt-liegende, though even in Russia there are tracts in which underlying grits with plants represent that German deposit. But the great fact which I established by visits to all the classical districts of Germany before the publication of the work on Russia and by comparing them with those of Russia is, that whether the pebble-beds and sandstones underlie the Zechstein as in Germany or are intermixed with and chiefly overlie all the limestone as in Russia, the plants of the two regions have been pronounced to be identical. These plants are related generically to the Carboniferous forms, whilst on the authority of Göppert they are pronounced to be entirely distinct from those of the Trias.

In short, the whole geological series does not offer a more complete discordance of type between any two conterminous groups than that which exists between the fossils of the Permian and those of the Trias, whether we refer to their respectively imbedded reptiles, fishes and shells, or to their plants; the one set marking the close of Palæozoic, the others the commencement of the Mesozoic era. Yet these are the two deposits which M. Marcou unites in *one natural group* under the name of New Red Sandstone.

To conclude, let me request you, Messrs. Editors, to have the goodness to translate into English the concluding page of the memoir of M. Marcou, beginning "En resumé," &c., and I will then require no other reason to induce plain geologists to side with my associates and self, by retaining in the great palæozoic division of life, the inhabitants of the Permian era, and by op-

posing the views of an author who considers such fossils to be the remains of "precocious beings"—the 'precursors,' or 'advanced guard' of the secondary or Mesozoic populations!"

I remain gentlemen, your very obedient servant,

RODERICK I. MURCHISON.

Geological Survey Office, London, July 25th, 1859.

P. S.—Informing his readers that my eminent friend M. d'Omalius d'Halloy had named the same rocks Penéen ('poor') which I afterwards termed Permian, M. Marcou should recollect, that when I wrote my first letter on the subject to Dr. Fischer at Moscow in 1842, I was far distant from any works of reference. When, however, I consulted the 'Eléments de Géologie' of d'Omalius, published in 1831, I found that although that sound geologist had widely separated his 'Penéen' from the 'Terrain Kuprique,' he still maintained as a part of the group the 'New Red Sandstone,' from which the Permian was specially distinguished. Moreover, I much preferred a purely geographical name taken from a country where fossils abounded, to a term which implied poverty of fossils. In fact, M. d'Omalius tells us (p. 276) that his name Penéen was intended as a French translation of Roht-todt-liegende, the examples of which rock, best known to the Nestor of Belgian geologists, near Malmedy, are indeed quite sterile, as I know from personal examination long before I visited Russia.

The following is the summary of Mr. Marcou, called for in the last paragraph of Sir R. I. Murchison's letter.—EDS.

"To sum up, I am led to regard the New Red Sandstone comprising the Dyas and Trias as a great geologic period, equal in time and space to the Palæozoic epoch, or the Graywackés (Silurian and Devonian), the Carboniferous (the Mountain Limestone and Coal Measures), the Mesozoic (Jurassic and Cretaceous), the Tertiary (Eocene, Miocene and Pliocene), and the recent deposits (Quaternary and later). I also restrict the limits ordinarily ascribed to the Palæozoic and the Mesozoic, and give them proportions more in harmony with those of the Tertiary and recent epoch—to the end that we may have a well balanced and natural classification.

"In the 'New Red' as well as in all other great epochs, we remark that the lower beds (the Roth-liegende) contain Carboniferous forms of life—a kind of '*rear guard*' of the populations whose destruction had commenced, indicating that there were some organisms endowed with a vital force superior to that given generally to other beings, permitting them to witness the disappearance of all their contemporaries, and at the same time to become the spectators—but *isolated spectators*, of the advent of new generations, which, although composed of beings somewhat

nilar to their predecessors, are endowed nevertheless with her forms, and of necessity therefore with other habits, asso-ıtions, and aspects—exactly like the centenary in our human cieties. On the other hand, the upper beds of the New Red, ch as the 'Halstatter Kalk,' the 'Raibler Schichten,' the 'Bone-d,' or the Keuper contain forms indicating the approach of other geologic period of secondary beds (Jurassic and Cretace-s), beings which Professor Quenstedt has happily designated the '*precursors*' or '*advance guard*' of the Mesozoic popula-ns. Precocious beings, these precursors, recalling generally their sudden appearances and disappearances, those comets hich coming from time to time announce that great events are the point of fulfillment. Or, better still, they may be com-red to plants which, forced in hot-houses, flourish in the win-r, in place of awaiting the spring and whose pale-tinted flow-s, and etiolated or disproportioned forms, appear as if they iew that they were before their time, and as if it was only a ecies of tentative experiment, which they were performing and they hastened to disappear to make room for the vigorous d abundant flora of the warm season."—*Bibliothèque Univer-le* (*de Genève*), Juin 20, 1859, pp. 145, 146.

[*Obs.* It will be interesting for the reader to turn from Mr. arcou's "rear guards, isolated spectators," and "advance ards," to the plain prose of facts observed by Dr. Newberry in ew Mexico, on the site of our author's assumed Jurassic beds. e p. 298.]

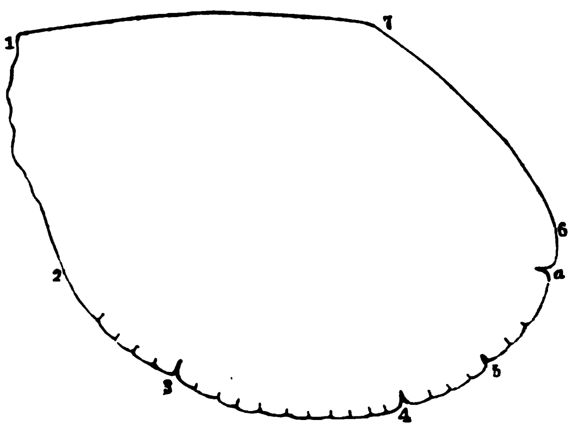
RT. XXXII.—*Examination of a supposed Meteoric Iron, found near Rutherfordton, North Carolina;* by CHARLES UPHAM SHEPARD.

FOR my first knowledge of this Iron, I am indebted to Dr. iomas S. Duffy of Rutherfordton, who in the winter of 1857 sually mentioned to me at Charleston, that he had been shown very remarkable specimen of an ore found in his vicinity, of e character of which no one had been able to pronounce a tisfactory judgment. From his description of its lustre and lor, and of certain striæ on one or more sides of the mass, I nceived it might prove a large crystal of mispickel. He as kind enough on his return home to send me in a letter, few grains that had been chipped from the mass. These I und to be slightly malleable and magnetic, while they suf-red no sensible alteration before the blowpipe;—properties at at once excited my curiosity, and led to my requesting Dr. uff to purchase the specimen for me. Sometime elapsed be-re he was able to effect the object, chiefly owing to the removal the original proprietor to a distance from Rutherford. In

November, 1858, however, he sent the specimen to me by the hand of Rev. Mr. Bowman; and a month after addressed me the following note, in reply to several interrogations I had propounded. "I have been considering the questions you asked me relative to the nondescript specimen I sent you by Mr. Bowman. It was ploughed up at the foot of a hill near a small water-course, named Sisemore Branch, about half a mile from where it empties into Second Broad River, and four miles from Rutherfordton. It was found by a man named Pinner, who has since removed to the southwest. Search was made, but no similar piece was discovered, although iron ore of good quality was found. There are no iron-works in the neighborhood. This is all the information I am able to communicate about a substance which has puzzled us all here. You will oblige me by retaining it in your possession, till I can say something definite as to its ownership."

My perplexity was greatly increased on the inspection of the mass. Its weight was three pounds and three quarters, and its specific gravity, 6·745. Its shape was imperfectly cylindrical; and it measured a little above three inches in length, by rather less than three in one of its diameters, and two in the other. It was moreover slightly tapering in its figure,—having evidently been broken directly and evenly across at each extremity, from connection with a longer mass, that may have been stalactitic in shape, or even drop-form, like the Charlotte meteoric iron, that was seen to fall August 1, 1835. Almost the first impression created by the fragment is, that it is cast-iron or steel, that has been run in a mould formed by a fossil Calamite, supposing also that the surface was afterwards perfectly cleared of any crust or film, and polished throughout at every point. Singular ver-

1.



tical striæ prevail on one side of the flattened cylinder, while on the other half, a totally different style of marking is visible.

The nearer the view however, the less striking is the resemblance to any species of casting: and the shape is seen to conform but very imperfectly to a section of a Calamite; for, strictly speaking, the mass is only semi-cylindric in figure, three-fifths of the remainder being flat, and the balance but slightly convex.

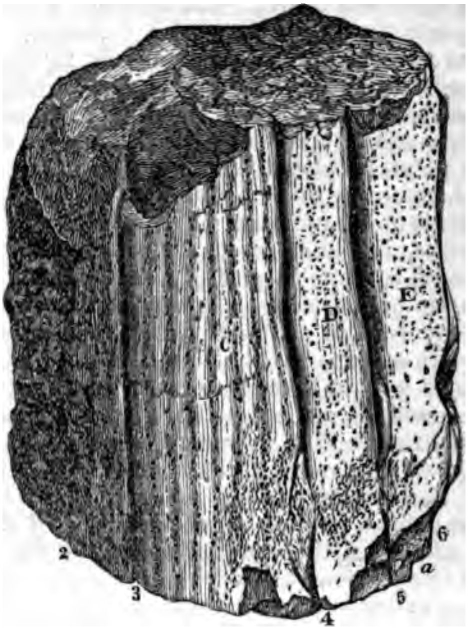
The first sketch presents an outline of the smaller base.

The same general figure would be afforded by cross-sections made at any point, between the base and summit of the mass; and it may therefore be employed to describe in part, the character of the sides of the cylinder. From 1 to 2 is a pitted, wavy, irregular surface, like that ordinarily seen on true meteorites. Between 2 and 5 is the most perfectly turned and smooth portion of the cylindric surface. Its symmetry is nearly complete, except for four vertical channels or grooves, one-sixteenth of an inch in depth and one-eighth across at top. These have convex sides which meet at bottom so as to touch without actual coalescence,—continuing distinct, though in apposition, for a depth of nearly one-tenth of an inch. In several places also the entire channel of the groove, for the distance of nearly an inch, is filled with the substance of the mineral, as if the matter had flowed into and filled it after the solidification of the sides. It is noticeable also, that the external surface of the matter thus introduced is exactly smoothed off, and pitted, to correspond to the rounded cylindric surface of the mass. These grooves occur at 3, 4, 5 and *a*. Between the grooves are numerous perfectly parallel and equidistant vertical lines, made up of slight punctures or depressions. The punctulated striæ are denoted as to number and position in the figure, by the inwardly projecting points. Other dots are here and there visible also upon the surfaces, intermediate between the punctulated lines, all of which are seen in the second diagram, where a full representation is given of the grooved semi-cylinder itself. Portions of the groove which have been filled up are seen near the bottom. The punctulated lines are denoted on B, C and D. They are less visible on E, while A is undulous and pitted, as in meteorites generally. The side of B, contiguous to A, has a character intermediate, between the broad-pitted and the punctulate.

The opposite side (fig. 3) of the mass is perhaps the most anomalous in its markings. The flat surface F (from which a considerable fragment has been chipped off at *g*) is smooth, with the exception of a multitude of finely pectinated wrinkles, or wave-like elevations, which to the axis, are almost horizontally disposed. These are interrupted in their continuity by several nearly smooth spaces, or channels, running cross-wise from top to bottom, as if produced by the pressure of a broad gravure.

Other lines still more delicate come into view with the aid of a glass, forming a complication of patterns exceedingly delicate,

2.



3.

t too intricate for description. They do not however possess y analogy to the etchings on meteoric iron, steel or cast-iron. The surface G at its uppermost portion (or to the right in the ure) is almost perfectly smooth, presenting only a faint resem- ınce to the flat side, in the presence of a few nearly obsolete inkles. At the middle region, however, these elevations be- ne more strongly marked; while still lower down (to the left) ;y degenerate in regularity and pass into the pitted and undu- ıs surface, as they form the interior of a crateriform cavity ly half an inch deep, by three quarters of an inch across at its ening. The appearance of this cavity at once suggests the :a that a blunt solid was thrust into the matter when nearly ıgealed, forcing it into the large wrinkles or waves which 'm the circumference of the crater. Indeed, it appears highly ›bable that all the undulations and crimpings, large and small, ginated in the foreign body that produced this deep cavity. ›ry little stress however could be attached to an explanation such various and unusual appearances as this mass presents, d I could venture upon no conjecture of its origin as a whole, ›re probable, than that the matter of which it is composed had wed originally into a cavity in some earthy, refractory mate- l, where it slowly suffered congelation, pressing with greater ce perhaps against the walls of the cavity on the striated or ni-cylindric side than upon the other. In any case, it seems ite certain, that its formation occurred with entire exclusion atmospheric air; and if a meteorite, it must have been pro- ted by a covering of stony matter, until it reached the surface the earth. The strangeness of external aspect was regarded affording a certain degree of probability in favor of its mete- c origin; since all who have studied these productions atten- ely, have recognized in them traits, wholly inexplicable from r knowledge of merely terrestrial matter.

Chemical experiments soon proved that the mass was essen- lly composed of iron and silicon, with an unusually high pro- rtion of the latter element; a discovery again, that pointed th some significancy towards a meteoric origin, provided the ificial source should also be rendered improbable: for up to s moment, no mineral belonging to our earth has presented icon combined with any other element than oxygen. I has- ıed to communicate my result to Dr. Duffy, from whom I ›eived (Jan. 1, 1859) the following additional information. . had the pleasure of receiving yesterday, your note of the th ult. The account you give me of the mineral I sent you is ry interesting. I beg you will accept of the mass from me. It ıs found in the spring of 1855. There is no evidence of iron er having been made near the place. I shall be able to send ›u some iron-ore from the same locality, when an opportunity

occurs. The nearest place of iron manufacture is High Shoal (supposed to be twelve miles distant from where the specimen was found). Before I sent it to you, I showed it to several persons connected with this furnace; but they were all equally puzzled to make out what it was. The general conclusion arrived at being, that it was of a mineral character."

As yet I have received no specimens of the iron-ore said to be found at the spot. The geology of the region however is known to be primary, it being fully within the auriferous formation. It is probable that the occurrence of iron-ore at the spot is purely accidental, as such ore is widely distributed throughout the gold region of the southern states.

The supposed meteorite breaks with greater facility than cast-steel, first undergoing a slight condensation, if struck with the edge or the corner of a hammer. The fractured surface is somewhat even, of an iron-grey color, and yields feeble reflections of light in rather broad irregular patches, in shape most resembling those produced on a surface of a coarse-grained dolomite. Besides the broader patches of light from large foliated individuals, are others from frequent scaly points, that are much brighter. The lustre of the exterior is much higher, and the color is lighter also, than that of the fractured surface. Both are nearly identical with those of polished platinum, though the color inclines slightly to that of graphite.

The mass is not wholly without vesicular cavities; but these are very rare, and can scarcely be detected without the aid of a glass. One of them is quite round, with smooth, shining black walls, (probably enfilmed with black oxyd of iron) and another near by, which is elongate and irregular, contains a distinct particle of quartz or silica. It may be mentioned here, that several similar grains, but too minute for detection with the naked eye, were left after the solution of the other constituents of the mass in acids.

It nowhere shows the remains of any coating or crust, and is equally free from evincing the slightest tendency to oxydation or tarnish; and such is the delicacy of the raised lines, punctures and sinuses of the surface, it is impossible to believe that it ever had any such investiture.

The hardness is 7·5 on the mineralogical scale, scratching quartz quite easily, when its sharp angles are applied to rock crystal. A Sheffield cutler pronounced it harder by far, than any steel. He was unable to temper it. When suddenly heated and struck with a hammer, it flew to pieces like glass. A fractured surface was smoothed, and with some difficulty, etched with aqua regia. Its color (unlike to etched steel) was but slightly darkened; and the pattern developed was simply that of a coarse grained saccharoidal limestone, rubbed down to a surface on

sandstone and then moistened. It chips off under blows from the hammer into thin scales, which are easily crushed to powder in a steel mortar. It may then be ground to an impalpable powder in an agate mortar, with greater facility than many earthy minerals of inferior hardness.

The following observations, showing the remarkable passivity of this iron were next made. It is not attackable by dilute sulphuric acid. If previously reduced to powder, a very feeble action is set up, which proceeds with activity as soon as heat is applied. It does not precipitate copper from an acid solution of the cuprous sulphate. In nitric acid also, there is no action, unless the acid is concentrated and slightly warmed, when a few bubbles of binoxyd of nitrogen appear. The surface however does not become sensibly corroded. Hydrochloric acid gives rise to a coating of bubbles only; and if the mass was previously polished, its surface when washed and dried, is found to have grown a shade darker, and to have lost its metallic lustre, attended with the developement of imperfect lines of crystallization.

A few grammes in the state of powder were treated with hydrochloric acid at the temperature of 80°. The extrication of hydrogen gas was gradual, unattended by any sensible production of heat. The action was considerably promoted by slight agitation. On heating to 90°, the decomposition of the hydrochloric acid was much promoted; and the gas was tested, and found to be pure hydrogen.* After some hours, a strong yellowish green solution was obtained; and a film of the same color lined the flask for some distance above the level of the liquid. The flask being left in a state of rest for some time, fell in temperature to 65°; and its contents assumed a partially gelatinized form. On the slightest agitation, its consistency was somewhat dispersed, attended by a singular decrepitation, resembling the ticking of the water-hammer, on the agitation of the fluid in Wollaston's cryophorus. This continued as often as the flask was moved, for many minutes; and was unaccompanied by any sensible extrication of gas. The occurrence of this phenomenon was verified in several repetitions of the solution, and remains at present wholly without an explanation.

One portion of the solution was examined by sulphuretted hydrogen for other metals, without their detection. Another on being cleared of the iron, was found to contain faint traces of magnesium. The main portion of the hydrochloric solution, turbid with the imperfectly suspended silica, was transferred to a filter, upon which the latter was left in a voluminous state, and possessed a dark greyish tinge, as if from the presence of traces

* With strong hydrochloric acid at a lower temperature (say 65°) beautiful green tabular crystals are formed, supposed to be a hydrated double chlorid of iron and silicon.

of carbon (possibly also of silicon). The affusion of hot water produced an instantaneous effervescence, from the extrication of hydrogen. This was continued by subsequent additions, until the acid was almost completely removed, when the hydrated silica occupied the bottom of the filter, having a somewhat lighter shade of white, and on being turned out and broken up, was found to be filled with rounded, amygdaloidal cavities. This singular action of the hot water may proceed from the subversion of a compound present, consisting of the chlorid of silicon and hydrochloric acid, its decomposition being occasioned by the washing out of an excess of hydrochloric acid (aided by heat), —the new bodies eliminated being silicic acid, hydrochloric acid and hydrogen. Thus

$$SiCl, HCl+3HO=SiO^3, 2HCl+2H.$$

Or the effervescence may be occasioned simply by the decomposition of water (aided by heat), through the presence of free silicon.

The silica was so light as to require much care while drying it in a broad platinum capsule; and just prior to its ignition, a bright glow set for an instant through its entire mass, produced by the combustion of a trace of carbon.

The first determination of the proportions of the iron and silicon gave as follows:

Iron, - - - - - - - - -	84·00
Silicon, - - - - - - - - -	13·57

It occurred to me at this stage of the investigation to determine, whether a compound so rich in silicon would yield a pure chlorid of silicon, if chlorine were presented to it under favorable circumstances. Accordingly, a current of dry chlorine was transmitted over the powdered mineral in a glass tube, the reaction being aided by the heat of an alcoholic lamp. Arrangements were made for condensing the product in a letter U tube, surrounded by a freezing mixture. As soon as the chlorine began to traverse the heated powder, a brilliant red glow attended by scintillations in spots, appeared in the tube for the distance of half an inch (from the end nearest the source of the chlorine); and a dense yellowish smoke was emitted for a moment, from the exit tube. The action in the tube was kept up for several minutes. It now and then burst into an explosive combustion, and dashed an orange red vapor upon the tube, which was afterwards coated red-brown by a crystalline precipitate, and wetted also by a thin liquid that could not be forced to enter the cooling apparatus. At the close of the experiment, a very small quantity of a pale yellow liquid was found in the condensing tube. In this, a few drops of water produced hydrochloric acid and gelatinous silica. A portion of the liquid was also

sted after the precipitation of the silica for iron, unattended by s detection, even in the minutest trace. The volatile product as therefore considered as terchlorid of silicon.

But the charge in the tube which had suffered combustion, as found to be swollen to three times its original bulk; and was r the most part in beautifully perfect hexagonal crystals of a ood-red color, like the minute forms of volcanic hematite. hese crystals were found to possess very remarkable properties, few of which may here be mentioned.

The tube in which they were formed was carefully corked, so to exclude the air. On allowing a few of them to fall into a y test-tube, and held in the sun's rays, they turned a deep yellow ith a tinge of green, and quickly coiled up and shrivelled,— the same time, emitting a peculiar ethereal odor.

In the process of sealing hermetically the tube in which the ystals had been formed, a considerable jet of vapor issued from e heated end, and burned with a bright light, attended by a iite smoke. As all moisture had not been excluded from the wder, it appeared probable that this combustion was partly to ascribed to siliciuretted hydrogen; and the smoke was at-buted to silicic acid.

The red crystals in the air, out of the sun's rays, deliquesce pidly, forming a blood-red solution; and are soluble in ether d in water: ammonia throws down from either solution, a xture of silicic acid and peroxyd of iron.

On heating the contents of the sealed tube to between 250° d 300°, the red crystals are speedily volatilized, and condense quickly on cooler portions of the tube immediately contiguous, the precipitated crystals filling the cavity of the tube, and per-ming the most extraordinary movements, like the gyrations falling snow-flakes.

When the red crystals are heated in a tube with considerable cess of air, they turn yellow, giving rise to a pale yellow por. This on cooling, leads to a greyish white coating on the ss, and the formation of a voluminous greyish powder, which being treated with warm water partly dissolves, leaving silicic id behind. The solution is precipitated by ammonia, of a nish green color at first, but afterward turns to red brown. I n therefore led to regard the red crystals, as a compound of squichlorid of iron and chlorid of silicon; and suppose that the esence of air (aided by heat) changes it to one, of the proto-lorids of iron and chlorid of silicon, with formation of silicic id,—possibly to a compound of protochlorid of iron and silicic id only.

The unusual results obtained rendered me desirous of commu-cating them for correction and advice, to Prof. Wöhler of Göt-ngen, a chemist who had especially occupied himself not only

with the analysis of meteorites, but with the study of silicon and its more difficult compounds. I accordingly forwarded to him an outline of my results, accompanied by a few grammes of the iron, and solicited his opinion upon the subject. He had the goodness to have an analysis performed for me under his eye, and to engage in some experiments himself upon the material sent.

The analysis afforded the following result:

Iron,	87·10
Silicon,	10·60
Graphite,	0·40
	98·10

Of which he remarks, that without claiming for it the most rigorous exactness, it is sufficiently accurate to show, that the composition of the mass is essentially a compound of Fe^6Si, or one of

Iron,	88·80
Silicon,	11·20

(Silicic acid being assumed $=Si\ O^3$).

He then observes, that it subsequently occurred to him to examine the precipitated peroxyd of iron for phosphoric acid; and that he detected therein, a strongly pronounced proof of its existence. This discovery induced him further to say, that the presence of phosphorus points to its meteoric origin, notwithstanding the absence of nickel in the mass.

I have since made a determination of the phosphorus, and found it to amount to 1·312 p. c.; and combining the numbers of the calculated result upon the iron as being composed of $Fe^6\,Si$, and employing therewith Wöhler's determination of the carbon and my own of the phosphorus, the present statement is believed to be a close approximation to the composition of the Rutherfordton mass:

Iron,	87·279
Silicon,	11·008
Phosphorus,	1·312
Carbon,	0·400
Magnesium,	*trace*
	99·999

We recur once more to the question of its origin. It is admitted that it was found in a region containing iron ores, and that the manufacture of this metal had been carried on, though to a very limited extent, at the distance of ten or fifteen miles from the place of its discovery. It is with difficulty supposable that so considerable a mass of a compound before unknown in

chemistry or metallurgy should have originated in such a source. Karsten, the highest authority perhaps upon the products of iron furnaces, says, that the greatest quantity of silicon he ever found in raw iron (pig-metal) was 3·46 p. c.; and that this large proportion occurred under very rare circumstances. Stromeyer who studied the modes of combining iron in silicon with much care, succeeded in uniting them in proportions between 2·25 and 9·3 p. c. of silicon; but in the cases of the higher proportions of silicon, he found the carbon increased also steadily in the compound, to a very high per centage. It would hence appear, that the trifling amount of carbon in the Rutherford mineral, militates against the view of its furnace formation: nor is it probable that it originated in a refinery; for Karsten distinctly asserts, that in that process, the silicon is mostly separated and slagged off. Can it be a natural, terrestrial product, originating after the manner of a fulgurite? Heat enough has perhaps been produced, during the most powerful discharges of lightning to melt a mass of this size; but it remains for us to conceive of the electrolytic action, which should unlose and bring together from any rocks or minerals within our knowledge, such elements as are here found. As bearing upon its meteoric origin, however, we may adduce its peculiarity of shape and structure, the presence of phosphorus, silicon and magnesium,—all of which, as here combined, are eminently meteoric constituents. But as no body has been seen to fall from the skies possessing a similar constitution with the Rutherfordton mass, we are obliged for the present to admit, that the proof of an extra-terrestrial origin remains incomplete; though we may perhaps be allowed to claim, that the evidence already preponderates in this direction.

In a report on meteorites submitted by me to the American Association in 1848, I proposed an order of brittle, metallic meteorites, to provide a place for several examples then regarded by me as meteoric, viz: one from Randolph county North Carolina, another from Bedford county Pennsylvania, together with a third from Otsego county, New York,—this last differing from the first two in important respects as to composition, and which I placed in a section by itself, under the order. The two first mentioned agreed in not containing either of the substances then supposed to be characteristic of true meteors; while that from Otsego, possessed those constituents in the fullest manner. For these reasons, I have thought proper in my later printed catalogues of meteorites, to place the Randolph and Bedford localities among the doubtful meteoric irons, where their number has unexpectedly been augmented by the discovery in Montgomery, Vermont, of a third, possessing the same general properties. I may now add, that the Rutherfordton iron approaches much more nearly to each of the three, than to any other kind of matter with

which I am acquainted. Still I cannot pronounce them identical, though my very imperfect examination had enabled me to indicate silicon from the first, as a constituent of the Randolph specimen. They were each found under circumstances equally favorable as in the case of the Rutherford iron, to the idea of their being natural productions. But unfortunately, the size of the specimens was so small as to render their full elucidation difficult. Nevertheless, I hope very soon to subject them anew to examination; and I think I may add, with every probability of establishing the real existence of the group of meteoric irons originally proposed, but which has temporarily been withdrawn from my classification.

As a convenient name for the Rutherfordton species of matter, I would propose that of *Ferrosilicine.*

ART. XXXIII.—*On a Shooting Meteor, seen to fall at Charleston, South Carolina, on the evening of November* 16*th*, 1857, *with notices of other supposed shooting meteors;* by CHARLES UPHAM SHEPARD.

IN calling attention to the matter of a shooting meteor, I am conscious, that the evidence of its genuineness is not absolutely perfect; nevertheless, it falls so little short of entire satisfactoriness, as to make it fully worthy of notice. No instance of the kind at least, has yet been recorded, entitled to so much confidence. In detailing the circumstances, I shall aim to present every particular, precisely as it came to my knowledge.

Mr. Sparkman R. Scriven, aged about 17, and clerk in the dry goods store of Messrs. Browning & Ketchum of King street, Charleston, a young man of excellent character, was the principal observer of the phenomenon. He had just returned, at half past 8 in the evening of Nov. 16th, 1857, to the residence of his father (Mr. J. M. Scriven) in Morris street, three doors west of King, and having occasion to step into the portico, he saw a red, fiery ball of the size and shape of an orange, slowly descending through a distance apparently of 20 or 30 feet, to the ground. Its fall was scarcely more rapid than that of a soap bubble, giving him time to call his sister, a little girl, to see it strike a high wooden fence, distant about fifty or sixty feet from the portico, and which separated the door-yard from a church enclosure adjoining. It seemed to adhere for an instant to the board against which it struck, and then separated into three parts and disappeared. The evening was dark, it having followed a rainy afternoon, though at the time of the fall, it had ceased to rain and become very foggy.

othing further would probably have been heard of the phe-
enon but for the accidental reading, by an elder sister
next day at the breakfast table, of a paragraph from the
spaper, relating to a meteoric fall, where the specimens
ed up were said to have possessed a strong odor of sulphur.
; induced young Scriven, who had never before heard of
eoric falls, at once to examine the fence against which the
had struck. The fence was eight feet high, and formed of
; strips of horizontally disposed boards. It was near the
emity of an uppermost board, that had been detached and
; around so as to present its flat side uppermost, that the
y had been seen to impinge. And here it was, that he dis-
:red adhering, a small bristling mass of black fibres. These
etached and carried into the house. As it had rained again
ng the night, he was led to suppose that the rest of the mat-
iad been washed away. He searched the ground among the
l grass, but not until after the second night, when much more
had fallen. He could find no more of the same material,
igh he gathered up numerous small fragments, which proved
e ordinary charcoal.

r. Scriven (the father) was so much struck with the appear-
: of the black fibres, together with the circumstances under
:h they had been found, that he requested his son to call on
Wm. Pettigrew, the family physician, and describe to him
t had happened. Two days however elapsed, before Dr.
igrew heard of the case. He immediately repaired to the
ie, where he was informed of the particulars as above de-
ed, and shown a mere pinch of the matter that had been
ched from the fence,—the principal portion of it having un-
inately been given to a young man of the neighborhood, an
neer at the depot of the Northwestern railroad, who wished
xhibit it to his friends.

r. Pettigrew immediately called to acquaint me of the case;
not finding me at home, we did not meet until the forenoon
he 20th, when he presented me the specimen gathered by
ven, and took me to the spot.

heard the statements repeated from the different members of
family, corroborative of those above presented, and examined
place upon the board, from whence the fibres had been gath-
. It presented no discoloration or appearance of having
i heated or charred, though for many inches on either side,
is slightly blackened in spots. This perhaps was not strange,
eavy rains had fallen since the occurrence; and it might
y be presumed, that all foreign matter would have been
tually detached. I examined the grass and soil on both sides
ie fence, without finding anything beyond little fragments
iarcoal, which are common enough in most places about the

premises of houses. We then took pains to find the individual to whom had been given the principal portion of the fibrous matter obtained from the fence; but had the mortification to discover, that having worn it in a paper wrapper for several days in his vest pocket, he had finally mislaid or lost it. Thus little more than a microscopically visible specimen of the shooting star remained for study and examination. Its entire weight is probably less than one-tenth of a grain. When viewed by a single pocket-lens, it seems to be a confused aggregate of short clippings of the finest black hair, varying in length from one-tenth to one-third of an inch. Each portion is straight or only slightly curved. Except in color, they remind one most of that variety of pumice stone from the Sandwich Islands, known as volcanic hair, or as "*Pele's hair.*" They do not seem very prone to break in handling, and appear slightly elastic.

They have been examined under compound microscopes of high power by several persons accustomed to the use of this instrument; but hitherto no one has ventured to suggest a relationship in their properties, to any known form of organic or inorganic matter. The following description is from a note, handed to me by my friend, Dr. F. W. Porcher of Charleston. "Black elongated bodies, perfectly opaque, round and solid; amorphous, not properly smooth, surfaces often furnished with warty dots or projections; rather glossy."

In fig. 1, I have enlarged Dr. Porcher's drawings of a few of the forms about four times, as they presented themselves to him, through a one-third inch object-glass. A few of the bodies are subspinose, and one or two decidedly bifurcate; others are cancellated, and seem capable of separation into smaller fibres. The surfaces are not always perfectly round.

I could spare only a few of them for a chemical trial. These were introduced into a small glass test-tube (previously well dried), and heated by contact of the flame of the blowpipe. They suddenly glowed with a brilliant light, at the same time emitting an odor most nearly resembling the bituminous. A distinct greyish skeleton of each fibre was left adhering to the glass. Barytic water being thrown into the tube was instantly rendered milky, thereby proving the existence of carbonic acid; and the subsequent addition of hydrochloric acid slowly caused the separation of the skeletons from the glass, which led me to infer the presence of silica as a part of the earthy residuum. The little bodies however were not annihilated by the process; but greatly to my surprise were easily seen, by the aid of a single lens, still floating through the clear liquid, preserving in a great measure their original form, with the exception only, of being rendered here and there transparent, as if about one-half of the black

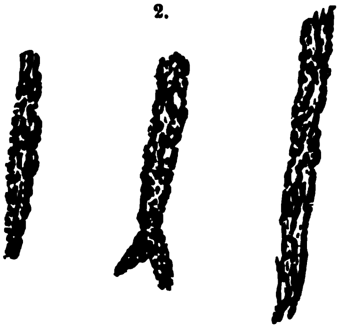
matter had been eaten out and dissolved, leaving the remainder sufficiently connected to maintain the original figure of the body. This honeycomb appearance is also represented in three of the drawings (fig. 2) made by Dr. Porcher.

1.

This is all that I have been able to ascertain concerning the origin, structure, and chemical composition of these singular bodies. They appear to be inorganic, though composed in part of carbon. A large proportion of earthy matter also, enters into their composition.

It will be remembered perhaps, in this connexion, that Berzelius detected what appeared to him to be an organic residuum (resembling burnt hay) in the French meteoric stone of Alais that fell March 15, 1806; and bearing more distinctly still upon our subject, are the highly interesting results recently obtained by Prof. Wöhler on the unknown substance of an organic nature (resinous) in the meteoric stone of Kaba, Hungary, that fell April 15, 1857, and those again arrived at by Prof. E. P. Harris in the Göttingen laboratory concerning the carbonaceous matter in the stone that fell Oct. 13, 1838, at Cape of Good Hope,— a meteorite originally described by Sir John Herschell and Prof. Faraday. Prof. Harris states in his valuable thesis on meteorites (Göttingen, 1859), that he finds a quarter per cent of bituminous matter in the Cape stone, which is soluble both in alcohol and ether, and fusible in a glass tube over a spirit lamp. It finally burns with a bituminous odor and the deposition of carbon.

2.



Is the matter of the Charleston shooting-star analogous to that of the Alais and the Cape meteoric stones? And if so, may the more complete combustion of its carbonaceous ingredient have been prevented by the humid state of the atmosphere at the time of its fall? These are questions that naturally suggest themselves, but to which we are not in a condition to return satisfactory replies at present.*

It is reasonable perhaps to suppose that many aggregates of meteoric matter, such for example as those made up wholly of one or more of the following meteoric elements: carbon, phosphorus and sulphur would, owing to their easy combustibility burn out, even in the upper regions of the atmosphere, and being resolved into gaseous compounds, fail of transmitting to the earth's surface any material proof of their existence. Others again may not be recognized at the surface of the earth, owing to the dispersion of their oxyds in the condition of an impalpable dust, or in solution in water. But however this may be, the facts seem thickening about us of the occasional arrival out of the air, of anomalous earthy bodies, whose descent is unaccompanied by the explosions belonging to the true meteorites, and the precipitated matter is uncharacterized also, by the possession of a thin, well fused coating or crust.

The study of these pseudo or doubtful meteorites, as they have been called, is worthy of a much closer attention than has hitherto been devoted to them; and it is to be regretted, that they continue still to be treated much as the true stones and iron masses were, prior to the time of Chaldni and Howard. Their study seems to be regarded as a field, exterior to the domain of legitimate science,—a region for the reception of all that is vague and contradictory. Much time and labor will no doubt be requisite to disentangle what is really entitled to scientific regard; but this desirable result will be yet longer postponed, if naturalists continue to dismiss as unworthy of investigation, every reported meteoric fall that is unattended with the stereotyped accompaniments, of the descent of the black encrusted stone and iron-mass, the frequency of whose arrival has now so multiplied, as to make the recital of their apparition almost monotonous.

Without here referring to many of the doubtful meteorites, of which I have from time to time given notices, I will venture to call attention to a few other instances, of which no scientific mention has yet been made,—not claiming for them however,

* As having possibly a close connexion with the subject in hand, may be mentioned, two instances recorded in Chladni's list of ancient meteorites. The first of these refers to the fall at Rockhausen near Erfort, July 5, 1582, ? during a frightful tempest, of a large quantity of a fibrous substance, similar to hair. The second occurred March 23, 1665 ? at a place near Lancha, not far from Naumburg, in which case, the matter that fell was likewise fibrous, and resembled a bluish silk. It was also abundant.

ny other character than that of mere hints, intended to awaken egard to a fuller investigation of analogous cases, as they may rom time to time present themselves.

It was not far from the month of August, 1834, that the ewspapers announced the fall of a blazing meteor in the night, n the town of Norwich, Conn. Its descent was unaccompanied by any report, and the mass of matter in its course, came near falling upon the roof of a house, missing it only by the space of about two feet, and nearly burying itself in the rather soft earth of the door-yard. The phenomenon occasioned much fright to the occupants of the house, who were only females. It was seen however, by others. The mass of matter occupying the cavity was of a flattened form, and nearly as large over as a man's head. It had the appearance (in the words of a neighbor who saw it and who described it to me a few weeks after) of a mass of earth, stuck together by the infiltration of tarry matter. And such he took it to be, supposing that some mischievous persons had prepared a fire-ball, and projected it on fire into the air, with the intention of alarming the inmates of the house. I was shown the cavity said to have been produced by the ball; but the specimen had been given to a medical student, who had sent it to his preceptor, residing in or near Albany, N. Y. The circumstances were on the whole so discouraging to the idea of its being a genuine meteorite, that I gave the subject no further consideration. It may not be too Lte, to recover further information respecting its character.

On the evening of the 23d of April, 1855, at Ochtertyre House, Crieff, in Perthshire (Scotland), a young woman saw from the third story, a shooting star or meteorite, falling with a brilliant light. It struck the gravel walk near to the house. She instantly called two other females, "who saw as it were, a bright object on the gravel, like the sun shining on a large diamond." Two of them ran out of the house and round a court-yard to the spot, taking matches and a candle with them. As soon as they got to the spot, one of them picked up two cindery fragments, which were too hot to hold, and which emitted a strong sulphurous smell. The other felt something hot under her foot, which she also picked up. It had a similar character with the other fragments. At first it was believed that these masses had actually fallen from the heavens; but a closer investigation into their character left little doubt that they were merely fragments of ordinary cinder, derived from a neighboring furnace, situated upon a stream, whence gravel had been obtained for dressing the walks. Being at Sheffield in England, when the subject was undergoing investigation, I was favored by Sir William Keith Murray, at whose residence the occurrence took place, with an inspection of one of the specimens, and was satisfied that a correct general view had been taken of their character. Nevertheless, as

the confidence of the gentleman referred to, was full and entire in the integrity of the witnesses of the phenomenon, it would seem to be an instance, in which the sulphurous matter of a shooting star was not completely consumed before reaching the ground, and that much of the residuum suffered oxydation after it struck upon the cinder of the walk.*

My meteoric cabinet has contained for many years, a few grains of a mixture of carbonaceous and earthy matter in a pulverulent state, sent to me in 1845 by Mr. Black, of Elizabethtown, Essex county, N. Y., (then a member of the Legislature of New York), as having fallen in his wood-yard during the winter of 1844 and 1845.

As an appendix to this unsatisfactory list of supposed meteorites may be added a statement concerning a specimen, the half of which is in my possession, so puzzling in its properties as to leave me in great doubt, whether to arrange it among terrestrial or celestial productions. Its history is briefly as follows. It was brought to Dr. Gibbs of Columbia, S. C., by a poor woman resident in the vicinity, under the impression I believe, of its having fallen from the skies; and as such, was presented to me by Dr. Gibbs. Its size is about that of an ordinary fig, which fruit in a compressed state, it somewhat resembles in figure. Its surface was nearly black, rough and without a glaze. It seemed hollow, and reminded me of an impure, brown iron-stone œtite. On breaking it open, it presented an irregularly shaped cavity, holding nearly a thimble full of silicious sand, and had upon its interior walls, little pellets (half the size of a mustard seed) of pure lead, almost exactly resembling those found in the Hemalga (Chili) meteoric iron.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On Ammonia-Chromium bases.*—Frémy has discovered a class of ammonia-chromium bases, analogous to those formed by cobalt, iridium and rhodium. The author, who appears to be ignorant of what has already been written upon the subject, distinguishes two isomeric modifications of the sesquioxyd of chromium, one of which he terms "chromoxyd" and the other "metachromoxyd," the latter being the soluble and the former the insoluble modification. When metachromoxyd is treated with ammonia in the presence of a salt of ammonium it dissolves completely, forming compounds which are distinguished by their beautiful violet rose red color: alcohol precipitates from these solutions beautiful violet substances, which the author terms amido-chrom compounds, but the analyses of which are not given. These substances are easily decom-

* It was found by Dr. Heddle of Edinburg, that the cinder still retains distinct *traces of sulphur.*

posed; among the products of their decomposition the author has discovered an ammonia-chromium base which has the formula $Cr_2O_3.4NH_3$. The constitution of the salts of this base may be represented by the general expression $Cr_2O_3.4NH_3+3A$, in which A represents one equivalent of acid. The solutions are almost pure rose-red—the chlorid, which the author considers as a hydrochlorate, has the formula $Co_2O_3.4NH_3+3HCl$. The salt crystallizes from an acid solution in the form of beautiful regular octahedrons; it forms crystallizable double salts with the chlorids of platinum and mercury. In addition, the author has discovered two other salts, which appear to contain different bases.—*Comptes Rendus*, xlvii, 883.

2. *On the preparation of Alizarin.*—VILMORIN has given a simple method of preparing alizarin from commercial garancin. Garancin is to be treated two or three times with a solution of pure ammonia alum in water, containing half as much alum as the garancin employed. The liquid after filtering has a very beautiful scarlet orange color. It is to be evaporated with repeated stirring, so that the alum may form only small crystals which are encrusted with amorphous alizarin. This product is to be dried, then rubbed to powder, and treated in a water bath with boiling bisulphid of carbon, which dissolves only the alizarin and leaves the alum which may then be employed again. The solution of alizarin in bisulphid of carbon has a brilliant gold yellow color; it is to be filtered and on cooling yields groups of crystalline needles, with a silky lustre. In place of bisulphid of carbon, boiling absolute alcohol may be employed.—*Chemisches Central-Blatt*, No. 24, 1859.

3. *On Wolfram-Steel.*—F. MAYR has prepared an alloy of steel with tungsten which appears to possess very valuable properties. Its tenacity, according to experiments made at the Polytechnic Institute at Vienna, exceeds that of all other varieties of steel hitherto examined, being equal to, on the average, 1159 cwt. to the square inch of section. The method of preparing this steel is not described; the ore of tungsten, as is well known, exists abundantly at Zinnwald in Bohemia and has hitherto found no practical application.—*Chemisches Central Blatt*, No. 25, 1859.

4. *On several new Alcohols.*—BERTHELOT has shown that cholesterine, Borneo camphor and meconine may be regarded as alcohols, since when subjected to the action of acids, water is eliminated and a class of neutral substances produced analogous to the ethers. The author's method of experimenting consists in enclosing the alcohol and acid together in a sealed tube, and exposing the mixture for eight or ten hours to a temperature of 200°. Under these circumstances combination usually occurs with facility. The compounds of cholesterine with stearic, benzoic, butyric and acetic acids, are solid and crystallizable; more fusible than cholesterine, more or less soluble in ether, very slightly soluble in boiling alcohol. Their physical properties, fusibility, etc., are intermediate between those of the waxes and resins. When treated for a long time with the hydrated alkalies at 100°, these ethers are resolved into cholesterine and acid which remains united with the alkali. The author concludes from his analyses, that the true formula of cholesterine is that of Gerhardt, viz.: $C_{52}H_{44}O_2$. Meconine in combining with acids loses four equivalents of water; the author succeeded in preparing a benzoate and stearate. He farther points out the relations which exist between meco-

nine, $C_{20}H_{10}O_{8}$, and the products of its oxydation, viz.: opianic and hemipinic acids; $C_{20}H_{10}O_{10}$ and $C_{20}H_{10}O_{12}$. These relations are the same as those between olefiant gas C_4H_4, aldehyd $C_4H_4O_2$, and acetic acid $C_4H_4O_4$.

Orcine, $C_{14}H_8O_4$, also appears to enter into combination with acids, though the quantity of matter at the author's disposal did not permit him to determine this with absolute certainty.

Borneo camphor $C_{20}H_{18}O_2$ plays the part of an alcohol, which the author proposes to call camphol. Camphol combines easily with muriatic acid at the temperature of 100°, and with the organic acids at 200°. The ethers are neutral, colorless, more fusible than camphol, sometimes liquid and sometimes crystallizable. In their formation, two equivalents of water are eliminated. The chlorhydric ether of this alcohol closely resembles the compound formed by the action of muriatic acid gas upon oil of turpentine, and commonly known under the name of artificial camphor, the only difference between them consisting in their power of rotating polarized light. The author did not however succeed in obtaining camphol by heating artificial camphor with an alcoholic solution of soda. Ordinary camphor may be regarded as the aldehyd of camphol, which latter can be obtained from it by boiling with an alcoholic solution of caustic potash. A peculiar acid is at the same time produced which has probably the formula $C_{20}H_{16}O_4$ and which the author calls camphic acid. Camphol is the type of a series of alcohols, represented by the formula $C_{2n}H_{2n-2}O_2$.—*Ann. de Chimie et de Physique*, lvi, 51.

5. *On a new Product of the decomposition of Trinitrophenic Acid.*—By the action of cyanid of potassium upon picric acid, Hlasiwetz has prepared a new acid which he terms isopurpuric acid, and which is isomeric with the purpuric acid obtained from uric acid. Two parts of cyanid of potassium are to be dissolved in four parts of water, the solution warmed to about 60° and the hot solution of one part of picric acid in nine parts of water added with constant stirring. On cooling, the solution becomes a soft mass of crystals, which after purification are brown red and scaly, and reflect a green light. These crystals are the potash salt of the new acid; they are slightly soluble in cold, but perfectly soluble in boiling water. The solution has a very intense and pure purple color. The salt explodes on heating, and gives precipitates with several metallic solutions. The formation of this substance may be expressed by the equation

$$C_{12}H_3N_3O_{14}+3(C_2NH)+2HO=C_{16}H_5N_5O_{12}+C_2O_4+NH_3.$$

The author has analyzed and described various salts of the new acid and has compared its physical and chemical properties with those of purpuric acid. According to Grailich's observations, isopurpurate of ammonia is both crystallographically and optically similar to murexid. In fact, it is difficult to decide from the author's memoir, upon what grounds a distinction is to be made between purpuric and isopurpuric acids.—*Ann. der Chemie und Pharm.*, cx, 289. W. G.

6. *Sir H. Davy's Discovery of the Alkaline Metals: correction of a prevalent historical error in relation thereto.*—It has frequently been a matter of regret that in the history of the world the progress of science has held a secondary place to that of bloodshed, tyranny and political in-

trigue. The most trifling acts of kings and generals are recorded and commented upon, and any misstatement in regard to them is soon detected and pointed out to the confusion of the erring historian. But it is often found to be otherwise in the history of those things which have most benefitted mankind. The most reckless statements in regard to these pass unchallenged as unworthy of notice or rectification, and are disseminated by each succeeding writer until the authority in favor of the error preponderates (numerically at least) over that in favor of the truth.

A striking instance of this occurs in relation to Sir H. Davy's great discovery. Seeing it stated in Lardner's Hand-book of Electricity that it was with the great battery of two thousand pairs of plates belonging to the Royal Institution that Davy succeeded in decomposing the alkalies and resolving them into metals and oxygen, and knowing that such was not the fact, it occurred to me to look up the statements of other physicists upon this point. I was aware that Pouillet in his "Traité de Physique" (from which Lardner has largely copied) makes a similar statement; but this I was prepared to expect in the works of an associate of those savans who alleged to Napoleon that they were prevented from anticipating Davy's discovery only by the want of an apparatus of sufficient power. But that an English philosopher should fall into such a mistake somewhat surprised me, and I was still more astonished to find that British authors, long before the time of Lardner and Pouillet, had given currency to the same misstatement. Indeed so powerful was the array of testimony in favor of this error (at least so far as the *number* of authors went) that I was at one time tempted to doubt my own clear recollection of Davy's own record, and it was only by again turning to it that I could reassure myself. There however he mentions distinctly that the battery used consisted of only one hundred pairs of six inch plates; and still further, in a note to the Bakerian lecture for 1808, he states that many have been deterred from repeating these experiments, supposing that a battery of enormous power is required, and corrects this false impression by stating that one to two hundred pairs of plates in moderate action is amply sufficient. Seeing then that Davy himself deemed this error of sufficient importance to merit correction, perhaps I may be excused for calling attention to the propagation of it by so many respectable authors.

Turner's Chemistry is the earliest work in which I have found this error. In Murray's system (1819) the facts are minutely and correctly stated, but the power of the battery is not given. But what astonished me most was to find that Leithead, Secretary to the London Electrical Society, in a work published in 1837 ("Electricity—its nature, operation and importance," &c.) and dedicated to no less an electrician than Sir M. Faraday, the friend and pupil of Davy, makes the same erroneous statement in his book, page 183.

From Turner and Pouillet the error has spread to a host of minor authors until our scientific literature has become infected with it to a wide extent. Golding Bird, whose means of obtaining correct information were no doubt ample, seems to have labored under the impression that the discovery was made with the great battery; and even de la Rive in

his recent elaborate work on electricity (tome 1, page 46) falls into the same mistake.* Lardner in his Lectures even goes so far as to make an enthusiastic defense of Davy from the imputation that he owed this accession to his reputation to the fortuitous circumstance of his having access to the large battery of the Royal Institution. But he does not correct the error. A few of our minor authors (Bakewell for instance) seem to have read the Bakerian Lecture for themselves; and a few French authors, as Becquerel and Figuier, have nobly given Davy his due.

The extent to which this error has been copied shows with what servility many of our modern compilers of text-books follow the leadership of any great name, and how necessary it is to look to original authorities where accuracy is of the least importance. The facts to which we have called attention occupy no mean place in the history of chemistry, and as it was in Davy's time so it is now, many have been deterred from repeating these interesting experiments by an apprehension that an apparatus of great power is requisite. Such is however by no means the case. Singer states that a battery of fifty pairs of plates in good action are amply sufficient, and of the modern and improved forms a much smaller number is requisite. J. P.

Rochester, N. Y., July 26th, 1859.

[*Note by the Editors.*—Another remarkable example of the regular propagation of error from hand to hand, extending through a large portion of our scientific literature, is the story usually found in text-books, of the accidental discovery in 1790 of the science of galvanism by the twitching of frogs legs prepared for the repast of Madame Galvani. This fabrication is attributable to Alibert, an Italian writer of no repute. Galvani had for eleven years been engaged in an elaborate research on animal electricity, in which he used frogs legs as sensitive electroscopes. The error has been continued from the want of a careful distinction between the real discoveries of Galvani and of Volta. Galvani was an anatomist and physiologist, and he really discovered the existence of electrical currents in living or recently dead animals, and he justly attributed the convulsions of the frogs legs when made without a metallic arc—by contact of the exterior mucous with the interior nervous surface—as due to a nervous or vital fluid, the *true galvanic fluid*. The importance and even the reality of this discovery of Galvani was hidden by the splendors of Volta's pile, until in 1837, more than fifty years afterwards, Matteucci

* The words of M. De la Rive are—"La pile à auges independentes en verre ou en porcelaine avec couples metalliques mobiles, forme sous laquelle fut construite la pile de deux cents couples de l'Institution Royale de Londres, au moyen de laquelle Davy fit les grandes decouvertes qui out immortalisé sou nom." He here evidently alludes to the great battery of the Institution which consisted of two hundred *instruments*, each containing ten "couples" or pairs of plates, thus making 2000 pairs in all. (Davy, Elements of Chemistry, p. 152.) This battery was first used in May or June, 1810 (Phil. Mag., vol. xxxv, page 463), while the alkalies were decomposed October 19th, 1807. (Life of Davy by Paris, and Journal Royal Institution, vol. i, p. 360.) Another battery of 500 pairs of plates was constructed in May, 1808. But the battery used in the decomposition of the alkalies was constructed in 1803 and was very much worn at the time of Davy's discovery. We can find no record of any battery having been constructed for the Royal Institution which answers the description given by M. De la Rive, but if for "couples" we read "instruments" the description applies exactly to the great battery.

revised Galvani's original and correct opinions. Volta's discovery of the pile he announced in March, 1800, to Sir Joseph Banks, although he conceived his "contact theory" in 1796. Galvani died, however, in 1798 (Dec. 4), before the discovery of the pile, and yet we constantly read of the galvanic battery and the frogs legs as related facts of his discovery. It is worse than an anachronism to say that Galvani divided with Volta the honor of discovery of the pile, since he died before it was discovered. Prof. James D. Forbes, in his sketch of the progress of mathematical and physical science in the Encyc. Brit., (8th ed.) has given the best account of the labors of Galvani and Volta to be found in English. In that essay Prof. Forbes says (§ 765) respecting the discoveries of Davy, "Potassium was discovered in the laboratory of the Royal Institution on the 6th of October, (Oct. 19th ?) 1807, and sodium a few days later. The battery used contained 250 pairs of plates of 6 and 4 inches square." Davy in reality employed, it is probable, two batteries; one of *one hundred* pairs of 6 inch plates, and another of *one hundred and fifty* pairs of 4 inch plates.]

7. *On the Electrolysis of Sulphuric acid;* by Dr. ANTON GENTHER. (Liebig and Kopp's Annal., Feb. 1857).—The following experiments were undertaken for the purpose of deciding the question whether an electrolyte of different constitution than the simple binary relation of atom for atom of each element is capable of decomposition by the current. Previous experiments with chromic acid, chlorid of iron and chromate of potash, had well nigh decided the question in the affirmative, but the attempt to decompose sulphuric acid made with eight cells of Bunsen's battery by Prof. Magnus, failed to confirm this view of it. The failure Dr. Genther attributed to the limited force of the current, and accordingly renewed the experiment with fourteen of Bunsen's cells. The anhydrous acid still resisted, and even when the platina poles were approached so close as to ensure the direct transmission of the current, it only gave signs of a rapid bubbling movement. The anhydrous acid was next mixed with different quantities of acid of the constitution SO_3+HO, and the mixture exposed to the action of the same battery in a U-form tube. The proportions first tried were four of the anhydrous to one part of the other acid. This mixture yields a solution crystallizing at 68° F. It is therefore necessary to apply a higher temperature which is invariably obtained by the continued action of the current. The conducting power of this solution is so low as to allow only a very small distance to intervene between the poles. Soon after the action commences oxygen is liberated at the positive pole, whilst not a gas bubble appears at the negative. The solution however being of a brownish yellow cast, becomes colorless in the arm of the tube containing the positive electrode, the color being entirely confined to the other arm. The action being allowed to continue, blue streaks slowly make their appearance on the surface of the liquid at the negative pole, which although multiplied with the duration of the current, are yet very sparingly developed.

In a second mixture the proportions were three parts of the anhydrous acid to one of the acid SO_3+HO. This gives a solution of better con-

ducting power. As in the former experiment oxygen appears at the + pole, but much more copiously; and at the — pole a slight escape of gas bubbles is perceptible, whilst the blue streaks present themselves in greater quantity, coloring the liquid contained in the negative arm of the tube. The odor of sulphurous acid is also distinctly perceptible. With the continuance of the action the temperature rapidly rises, the escape of gas at the — pole is more abundant, sulphurous acid is formed, but the blue streaks diminish when the tube is immersed in water gradually heated, the blue streaks disappear altogether at 140° F., and a more copious formation of sulphurous acid sets in. As the tube containing the electrolyte is gradually cooled the color reappears.

This whole process is effected much more rapidly when the mixture is in the proportion of two parts of the anhydrous to one of SO_3+HO, or of equal parts of both, the temperature being kept at 32° F. The blue color at the — pole clearly proves that sulphur is liberated there, the solution resembling that obtained by dissolving sulphur in anhydrous sulphuric acid. Of this fact, the temperature at which decomposition takes place, and the formation of SO_2, furnish sufficient testimony independent of the color produced.

The development of sulphurous acid seems to be occasioned by the rise of temperature produced in the solution by the action of the current. Nor is it confined to the negative arm of the tube; circumstances which indicate that it is a secondary product.

In regard to the sulphur which has been observed as the negative pole, there are only two ways of accounting for its presence. It is either the result of direct decomposition by the current, or of the reducing action of the liberated hydrogen.

The combination SO_3 with HO, according to Faraday, is decomposed into sulphur and hydrogen at one electrode and oxygen at the other. The same combination subjected to the action of the battery by Genther gave at first only H and O at their proper poles; sulphur was liberated only when the temperature of the electrolyte was considerably raised by the action of the current. When the tube was placed in water kept at 32° F., the liberation of oxygen and hydrogen was of longer duration before free sulphur appeared. The temperature of the electrolyte was found to rise almost instantaneously with the removal of the tube from the water. This would seem to indicate that by keeping the electrolyte at 32°, the liberation of sulphur would be prevented, which shows the great influence temperature has on the product of the decomposition. It was further observed that the odor of sulphurous acid accompanied the liberation of sulphur, owing probably to the action of S on the warm sulphuric acid. If we assume that in this process the liberation of the sulphur is due to the reducing action of H, then it consistently follows, that the H endowed with so strong an affinity, must unite with the sulphur it meets at the moment of separation, and form sulphuretted hydrogen. Not a trace of this gas has however been yet detected. Furthermore if the hydrogen could exert this reducing action, it would at most be but the reducing of SO_3 to SO_2. With such proofs drawn from experiment we must assume the direct decomposition by the current of sulphuric acid into S, which appears at the — pole, and oxygen at the + pole. It

ends on the concentration of the acid whether the extra decomposition water accompanies the foregoing products.

That an electrolyte differing from the simply binary constitution is able of direct decomposition by the current is thus shown in the case SO_3, and even with less room for doubt in the case of anhydrous omic acid, and chromate of potash, as the researches of Prof. Magnus ve.

II. GEOLOGY.

. *Teeth and Bones of Elephas primogenius, lately found near the tern fork of White River, in Monroe County, Indiana;* communicated Prof. T. A. Wylie.—On Friday, July 23d, in company with Prof. e, I visited the place where these bones were found. It is situated on farm of Jefferson Wampler, about a mile southeast of the town of port. On the 6th of June last, one of the young men, in whose possion the bones now are, found one of the teeth, which had been washed from the bank by a heavy rain. This led to a further exploration, l the discovery of the tusks and teeth and several fragments of the leton. The bank into which they dug is a stiff plastic bluish clay. bones were found at the depth of eight or nine feet, in a bed of sand lerlying the clay, all in confusion as if they had drifted there, and had rward been covered with the clay. The sand probably rests on sandne (Carboniferous) which forms the bottom of the brook not many ds distant. Several of the larger bones were so far decayed that they mbled on attempting to take them out.

The tusks are much broken and require to be bound with cord to keep pieces together. Some portions of the ivory are so soft that they ld to the knife like chalk. Toward the point of one of the tusks the stance is much harder. The intelligent young men, W. M. Craven l J. H. Richardson, by whom the discovery of these remains was de, deserve credit for the care they have taken in disinterring and preving them.

The bones consist of two tusks, four molar teeth, and several fragnts, viz., a piece of a rib, an end of the radius (?) much worn, measur- about seven inches across its concave surface, and a few spongy pors of the larger bones.

One of the tusks measures on the outside of the curvature eight feet, ot or more has been lost from the root, the cavity of which is filled h sand. The diameter of the root end is eight inches, the tusk varies y little in the size of the cross section till near the point. The projec- of the axis of the tusk on a plane is nearly a semicircle of a radius 30 inches. The deviation of the axis from the plane is but slight, ugh this could not be determined accurately on account of the transse cracks. The other tusk has lost a portion of the pointed extremity, ging from the appearance of the fracture, this might have been lost re the death of the animal. It measures five feet in length, and in meter is the same as the other. The weight of the larger tusk is 166 unds.

There are four molar teeth, two larger and two smaller. The largest asures, in the longer diagonal from crown to base, eleven inches; ver-

tically, eight inches. Across the grinding surface, four inches. The smaller molars are about eight inches, and five inches in the same directions. The length of the grinding surface on one of the smaller molars is six inches. The grinding surfaces of these teeth are nearly flat. The plates of enamel very perfectly preserved. In the larger of the teeth twenty of these double plates were counted; in the smaller, fourteen. The distance between the plates, and the interval between the pairs, is about one-fourth of an inch. They resemble some drawings I have seen of modern elephant's teeth, though the *flattened cylinders* of enamel in the case of the fossil are much more compressed and closer together than those of the recent teeth. The columnar structure, if it might be so called, was very evident in all, particularly in the smaller, where the cylindrical columns of enamel were distinct, and where also the gradual coalescing of three of these into one, could be distinctly perceived.

Indiana State University, Bloomington, August 1st, 1859.

2. *Eruption of Mauna Loa, Sandwich Islands;* (latest information in a letter to J. D. DANA from Prof. R. C. HASKELL, Oahu College, dated Kona, Hawaii, June 22d, 1859).—I have just returned from a second visit to the scene of the lava-flood on Mauna Loa. There is one fact which I observed, that I desire to communicate to you. The real source of the flow is about four miles above the two craters, which in February seemed to be the source. From this point down to the two craters, a crack in the mountain can be traced nearly all the way. At first it is no more than two inches in width, but gradually increases to about two feet. At the present time heat can be perceived in the crack within a few feet of the highest point. But little lava has issued from this crack above the two craters. During the first quarter of a mile, lava has oozed out in different places a few rods apart, to the amount of three or four cubic feet. Below this point there is a stream, now cold of course, a few rods in width. In this flow therefore there is no doubt that there is a continuous crack in the side of the mountain for four miles. How much farther this crack extends down the mountain cannot be ascertained, now at least, for the craters are still sending forth immense columns of sulphurous vapors, and the stream of lava is still flowing below them. This stream however is much smaller than it was in February, and is entirely subterranean for the first twenty-five or thirty miles, except that there are a few holes where the running lava can be seen. In some instances this stream is as much as forty feet below the surface. During this trip I went to the top of Mauna Loa. There is no perceptible action in the crater of Mokuaweoweo. The source of the present flow is probably about 11,000 feet above the level of the sea.

3. *Observations on the Ossiferous Caves near Palermo;* by Dr. FALCONER, (Proc. Geol. Soc. London, Athenæum, July 16, 1859, p. 86).—Dr. Falconer, in the first place, adverted to his previous communication, read on the 4th of May last, before his collections had arrived in England. In the present paper he submitted, with more detailed explanations, the materials on which his first statements were founded. Dr. Falconer then described the physical geography of that portion of the northern coast of Sicily in which the ossiferous caves abound, namely, between Termini on the east, and Trapani on the west. Along the Bay of Palermo, and

again at Carini, the hippurite limestone presents inland vertical cliffs, from the base of which stretch slightly inclined plains of pliocene deposits, usually about one and a half miles broad, towards the sea. The majority of fossil shells in these tertiary beds belong to recent species. At the base of those inland cliffs, but sometimes 50 feet above the level of the plain, and upwards of 200 feet above the sea, the ossiferous caves occur. One of the best known of these is the Grotto di Santo Ciro, in the Monte Griffone, about two miles from Palermo. This cave has been often described. Like many others it contains a thick mass of bone-breccia on its floor, extending also beyond its mouth and overlying the pliocene beds outside, where great blocks of limestone are mixed with the superficial soil. The bones from this cave had long been known, and were formerly thought to be those of giants. Some years since bones were here excavated for exportation; and M. Christol at Marseilles was surprised to recognize the vast majority of remains of two species of *Hippopotami* amongst bones brought there, and counted about 300 astragali. Besides the *Hippopotamus*, remains of *Elephas* also occur. Prof. Ferrara suggested that the latter were due to Carthaginian elephants, and the former to the animals imported by the Saracens for sport.

The government of Palermo having ordered a correct survey of this cave and its contents, it was found that beneath the bone-breccia was a marine bed with shells, and continuous with the external tertiary deposits. The wall of the cave to the height of eight feet from the floor had been thickly bored by *Pholades*; for the space of ten feet higher the side was smooth; and still higher up it was cancellar or eroded. Above the breccia were blocks of limestone, covered by earthy soil, in which bones of *Hippopotami*, with a few of those of *Bos* and *Cervus*, light and fragile, not fossilized as in the breccia, occurred plentifully. In his late visit to the San Ciro Cave, Dr. Falconer collected (besides the *Hippopotamus*) remains of *Elephas antipuus*, *Bos*, *Cervus*, *Sus*, *Ursus*, *Canis*, and a large *Felis*, some of which indicated a pliocene age.

Another cave, the Grotto di Maccagnone, about twenty-four miles to the west of Palermo, was lately the especial subject of the author's research, whose attention was directed to it by J. Morrison, Esq. In its form it differs from that of San Ciro, being much wider. Its sides show no Pholad markings nor polished surfaces, as far as they are yet bared. It has a reddish or ochreous stalagmitic crust covering the interior. It agrees with the San Ciro Cave in its situation at nearly the same elevation above the sea and above the tertiary plain; and in its enormous mass of bone-breccia and great accumulation of limestone boulders covered by the humantile soil with loose bones. The floor had already been dug over for bones. Beneath this (as shown by the section which Dr. Falconer made at the mouth of the cave) was the usual ochreous loamy earth (called "cave earth"), with huge blocks of blue limestone, which impeded the operations of search. Then a reddish-grey, mottled, spongy loam, cemented by stalagmite, occurring in thick patches, and called "cinere impastate" by the peasants. This covers bone-breccia resembling that of San Ciro, and, like it, is full of bones of *Hippopotami*. The remains of a large *Felis*, two extinct species of deer, and of *Elephas antiquus* were met with also. The last is characteristic of the other pliocene caves of

Europe. Coprolites of a large *Hyæna* occur in ochreous loam; and especially in a recess on the face of the cliff near the cave's mouth. A patch of the "cinere impastate" was found under the superficial earthy floor of the cave at one spot near the inner wall.

The author next described some remarkable conditions in the roof of the cave. About half way in from the mouth, and at ten feet above the floor, a large mass of breccia was observed, denuded partly of the stalagmitic covering, and composed of a reddish-grey argillaceous matrix, cemented by a calcareous paste, containing fragments of limestone, entire land shells of large size finely preserved, splinters of bone, teeth of ruminants and of the genus *Equus*, together with comminuted fragments of shells, bits of carbon, specks of argillaceous matter resembling burnt clay, together with fragments of shaped silicious objects of different tints, varying from the milky or smoky color of chalcedony to that of jaspery hornstone. This brecciated matrix was firmly cemented to the roof, and for the most part covered over with a coat of stalagmite. In the S. S. E. expansion of the cavern near the smaller aperture, a considerable quantity of coprolites of *Hyæna* was found similarly situated in an ochreous calcareous matrix, adhering to the roof, mingled with some bits of carbon, but without shells or bone-splinters. On the back part of the cavern, where the roof shelves towards the floor, thick masses of reddish calcareous matrix were found attached to the roof, and completely covered over by a crust of ochreous stalagmite. It contained numerous fragments of the siliceous objects, mixed with bone-splinters and bits of carbon. In fact, all round the cavern, wherever the stalagmitic crust on the roof was broken through, more or less the same appearances were presented. In some parts the matrix closely resembled the characters of the "cinere impastate," with a large admixture of calcareous paste. With regard to the fragments of the siliceous objects, the great majority of them present definite forms, namely, long, narrow, and thin; having invariably a smooth conchoidal surface below, and above, a longitudinal ridge bevelled off right and left, or a concave facet replacing the ridge; in the latter case presenting three facets on the upper side. The author is of opinion that they closely resemble, in every detail of form, obsidian knives from Mexico, and flint knives from Stonehenge, Arabia, and elsewhere, and that they appear to have been formed by the dislamination, as films, of the long angles of prismatic blocks of stone. These fragments occur intimately intermixed with the bone-splinters, shells, &c., in the roof-breccia, in very considerable abundance; amorphous fragments of flint are comparatively rare, and no pebbles or blocks occur either within or without the cave. But similar reddish flint or chert is found in the hippurite limestone near Termini.

In regard to the theory of the various conditions observed in the Maccagnone Cave, the author considers that it has undergone several changes of level, and that the accumulation of bone-breccia below and outside is referrable to a period when the cave was scarcely above the level of the sea. Dr. Falconer points out the significance of the fact, that although coprolites of *Hyænæ* were so abundant against the roof and outside, none, or but very few, of the bones of Hyænas were observed in the interior. He remarked also on the absence of the remains of small mammalia,

such as Rodents. He inferred that the cave, in its present form, and with its present floor, had not been tenanted by these animals. The vast number of *Hippopotami* implied that the physical condition of the country must have been very different at no very distant geological period from what obtains now. He considered that all deposits *above* the bone-breccia had been accumulated up to the roof by materials washed in from above, through numerous crevices of flues in the limestone, and that the uppermost layer, consisting of the breccia of shells, bone-splinters, siliceous objects, burnt clay, bits of charcoal, and coprolites of *Hyæna*, had been cemented to the roof by stalagmitic infiltration. The entire condition of the large fragile *Helices* proved that the effect had been produced by the tranquil agency of water, as distinct from any tumultuous action. There was nothing to indicate that the different objects in the *roof-breccia* were other than of contemporaneous origin. Subsequently a great physical alteration in the contour, altering the flow of superficial water, and of the subterranean springs, changed all the conditions previously existing, and emptied out the whole of the loose incoherent contents, leaving only the portions agglutinated to the roof. The wreck of these ejecta was visible in the patches of "cinere impastate," containing fossil bones below the mouth of the cavern. That a long period must have operated in the extinction of the Hyæna, Cave-lion, and other fossil species is certain; but no index remains for its measurement.

The author would call the careful attention of cautious geologists to the inferences,—that the Maccagnone Cave was filled up to the roof within the human period, so that a thick layer of bone-splinters, teeth, land-shells, coprolites of *Hyæna*, and human objects was agglutinated to the roof by the infiltration of water holding lime in solution; that subsequently, and within the human period, such a great amount of change took place in the physical configuration of the district as to have caused the cave to be washed out and emptied of its contents, excepting the floor-breccia, and the patches of material cemented to the roof and since coated with additional stalagmite.

4. *On the Bone cave in Devonshire;* by Mr. PRESTWICH, (Ibid.).—Mr. Prestwich gave in a few words the results of the examination of the bone cave at Brixham in Devonshire. The cave has been traced along three long galleries meeting or intersecting one another at right angles. Numerous bones of *Rhinoceros tichorhinus, Bos, Equus, Cervus tarandus, Ursus spelæus*, and *Hyæna* have been found; and several flint-implements have been met with in the cave-earth and gravel beneath. One in particular was met with immediately beneath a fine antler of a Reindeer and a bone of the Cave-bear, which were imbedded in the superficial stalagmite in the middle of the cave.

5. *Observations on a Flint-implement recently discovered in a bed of Gravel at St.-Acheul, near Amiens;* by JOHN WICKHAM FLOWER, Esq., (Ibid.)—The gravel capping a slight elevation of the chalk at St.-Acheul is composed of water-worn chalk-flints, and is about ten feet thick; above it is a thin band of sand, surmounted by sandy beds (3 feet 6 in.), and brick-earth (11 feet 9 in.). In this gravel the remains of elephant, horse, and deer have been found, with land and fresh-water shells of recent species. From the gravel Mr. Flower dug out a flint-implement,

shaped like a spear-head, at about eighteen inches from the face of the pit, and sixteen from the surface of the ground. Mr. Flower in this communication pointed out evidences to prove that this and many other similar flint-implements obtained from the same gravel were really the result of human manufacture, at a time previous to the deposition of the gravel in its present place. Mr. Fowler's visit to St.-Acheul was made in company with Messrs. Prestwich, Godwin Austen, and Mylne, with a view to verify the discoveries made respecting the occurrence of flint-implements in the gravel and peat of the Somme Valley by M. Boucher de Perthes, of Amiens.

6. *On Professor C. Piazzi Smyth's supposed proofs of the Submarine Origin of Teneriffe and other Volcanic Cones in the Canaries;* by Sir C. Lyell, F.R.S., D.C.L., etc., (Phil. Mag., July, 1859.)—Since the publication in the Philosophical Transactions of my paper on the Lavas of Mount Etna,* a Report by Prof. Smyth, Her Majesty's Astronomer for Scotland, has been printed by the Admiralty of Great Britain, "On the Teneriffe Astronomical Experiment of 1856," in which a chapter on geology and "volcanic theories" is introduced.

This chapter, which did not form part of the original report as published by the Royal Society in the Philosophical Transactions for 1858, contains a discussion of Von Buch's theory of craters of elevation, together with critical remarks on passages in my writings, and those of Mr. Poulett Scrope. I do not feel myself called upon to reply to any of these comments, as they relate to subjects to which the astronomer for Scotland cannot be expected to have devoted much time or attention; but when facts are cited, respecting Teneriffe and other islands of the Canariad Archipelago, supposed to be conclusive on a controverted question of high theoretical interest, and in a work brought out under the sanction of the Admiralty, I think it right to point out the mistakes into which the author has fallen, and the insufficiency of the evidence on which he relies.

At p. 553 of the new edition of the report above alluded to (dated February, 1859), the following passage occurs:—

"The question of the submarine origin of Teneriffe no longer depends only on the general structure of its lava-beds, or on analogies from the fossiliferous strata of the adjacent islands of Grand Canary and Palma, but has now the additional and most unanswerable argument of fossil shells having lately been discovered about the slopes of the crater."

And again in the same page:—

"The proof of fossil shells, so long demanded, has now been supplied; and with them must be accepted the fact of the slopes on which they rest having been once submarine, though now subaerial. The great crater, then, having incontestably suffered elevation, was that elevation necessarily connected with its present form and character?" &c.

When I first read these passages, I naturally concluded that some new discovery had been made of marine fossils *on the slopes* of the great outer cone of Teneriffe, or "crater," as it is termed in the report above cited; but having never seen or heard of such a fact myself when in the island,

* On the Structure of Lavas which have consolidated on steep slopes; with Remarks on the Mode of origin of Mount Etna, and on the Theory of Craters of Elevation, by Sir Charles Lyell, Phil. Trans. part 2, 1858, p. 703.

I wrote to Prof. Smyth to know where and at what height above the sea, and under what geological circumstances, he or his informants had detected these shells. In reply he could give me no information on any one of these three heads, "he had merely given the statement on report, and not from his own observations." It appears, then, that he had simply learnt that marine fossil shells had been met with somewhere in the island of Teneriffe, a fact well known before his visit in 1856, and before Mr. Hartung and I were there in 1854. These shells, however, did not occur "on the slopes of the crater," but in the suburbs of Santa Cruz, along the shore to the northeast of the town, a part of the island which is geographically and geologically independent, not only of the Peak, which is more than twenty miles distant, but also of that volcanic chain which extends many miles from the flanks of the great cone, trending in a northeasterly direction. The separation of the Santa Cruz rocks from the chain to which the Peak belongs, will be understood by a glance at the maps of Von Buch and Captain Vidal, and by reference to the view of Santa Cruz which Vidal has given in the margin of his map. The tufaceous breccias and sandstones containing marine shells near Santa Cruz do not conform "to the slope" of any crater or cone. So far as they can be seen, they appear to be nearly horizontal, and occur only at slight elevations above the level of the sea. We were told that the same remark holds good in reference to certain other deposits containing shells, which we did not examine, in the northeastern extremity of the island, still further from the Peak.

In the first of the passages above cited, Prof. Smyth has alluded to fossiliferous strata in the islands of Grand Canary and Palma. In regard to Palma, I may mention that Mr. Hartung and I, when we were there in 1854, searched in vain for fossils; no travellers had then found any; and our correspondents in the Canaries have still no knowledge of any having been obtained in that member of the Archipelago.

Lastly, as to the Grand Canary, Von Buch was, I believe, the first to call attention to the existence of marine shells in that island, where Mr. Hartung and I collected them in abundance in 1854, and ascertained that they are imbedded in nearly horizontal strata continuous over a large area, where they form an elevated platform about four hundred feet high, near the town of Las Palmas, a platform terminating abruptly in a range of cliffs near the sea, facing the northeast. These upraised sedimentary strata, with some intercalated basaltic beds, are far removed from the slopes of the great dome-shaped volcanic mass, which forms the central nucleus of the Grand Canary; and if they have any bearing on the question of "Craters of Elevation," they certainly do not corroborate that hypothesis, but, on the contrary are directly opposed to it; for though they have been upheaved in a district where intermittent volcanic action has never ceased, they do not dip away in all directions from a central axis, nor have they assumed a conical or dome-like form.

7. *The Old Glaciers of Switzerland and North Wales;* by Prof. A. C. Ramsay, F.R.S and G.S. London: Spottiswoode & Co. 1859. 8vo, pp. 69, with a map and 14 woodcuts.—This charming essay recalls in vivid coloring the reality of that icy episode in the history of Wales, of which every geological observer has seen there such salient proofs since

Agassiz and Forbes first taught us to open our eyes to the truth on this subject. Those who have not visited the classic scenes of Wales will find the excellent woodcuts of this essay quite a valuable substitute for personal observation.

III. BOTANY.

1. *Eulogy on Robert Brown;* by Dr. VON MARTIUS (translated from the German by Prof. Henfrey, and published in the Annals and Magazine of Natural History for May, 1859).—An eulogy upon "the greatest '*Pflanzenkenner*,' the world has yet produced," pronounced by one of his most distinguished survivors and intimate friends. One so learned, so genial, and so philosophical as Von Martius, cannot fail to interest and instruct, although somewhat of the glow and animation which we expect in the original may be lost in the translation. We are pleased to learn the curious fact, that a humble but peculiar North American plant, which has somehow found its way to the Irish and North British shores, may be said to have fixed the destiny of the great Botanist. Upon the completion of his medical studies, Brown, as is well known, was attached as ensign and assistant surgeon to a Scotch militia regiment stationed upon the western coast of Ireland.

"An inconspicuous plant with which he there became acquainted—the *Eriocaulon septangulare*,—the only European representative of an especially American order—caused his life to be diverted into the exclusive service of botany; for, accompanying a recruiting party of his regiment to London, in the summer of the year 1798, and on the road visiting his friend Dr. Withering at Edgbarton, near Birmingham, the latter caused him to introduce himself, with that plant and his researches upon it, to Dr. Dryander. This learned botanist, librarian to Sir Joseph Banks, astonished at the minuteness of the investigation, and the fullness of the conclusions derived therefrom, recommended the young military surgeon as a future master in botany; and Sir Joseph Banks from this time forward showed him a paternal kindness. He welcomed him as a regular guest at the celebrated literary breakfasts, during his five months' stay in London, and in December, 1800, proposed him to the Government as Naturalist to the naval Exploring Expedition to New Holland, under Capt. Flinders, then fitting out. Robert Brown, at this call, gave up at once the military career, came again to London at Christmas, 1800, and on the 18th of July, 1801, sailed in the 'Investigator' from Spithead to the newly discovered quarter of the globe." A. G.

2. *Fragmenta Phytographiæ Australiæ, contulit* FERDINANDUS MUELLER, Ph.D., M.D., Gubern. Col. Victoræ Phytologus, Hort. Bot. Melbournensis Director, etc., etc. Melbourne. Vol. I, fasc. 1—4, (pp. 96), 1858–9.—The British California in the southern hemisphere,—more enlightened and more spirited than our own,—has officially organized and promoted scientific research from the first. The colony has not only its Philosophical Institute, publishing memoirs of high character, but its Botanic Garden, Museum and Herbarium, under the charge of a Government Botanist, the able and indefatigable Dr. Mueller. Nor do they confine the energies of this officer to the Victoria Colony, but spared him to accompany, as botanist, the recent exploration by Capt. Gregory

of the northern part of the great Australian continent, where an extensive and interesting herbarium was gathered. A most enthusiastic and industrious botanist himself, Dr. Mueller awakes the interest and stimulates the activity of others; and vast collections, abounding in novelties, are rapidly accumulating in his hands. He has already published numerous scattered papers, in Germany, England and Australia. The publication now commenced has the advantage of a more convenient, connected form, and contains the characters of new genera and species, and rectifications of those published before, with important critical remarks, &c. A. G.

3. *Journal of the Proceedings of the Linnæan Society (Botany)*, Nov. 12, (1859): contains, 1st, the latter half of Prof. Henfrey's *Note on the Morphology of the Balsaminaceæ.* Balsams double [as do most blossoms] by an increase in the number of the whorls of the petals; and when merely one extra whorl of petals is developed, Prof. Henfrey finds these to alternate regularly with the five pieces which Rœper takes for the corolla; thus confirming Rœper's view (over that of Kunth) by evidence from within, of the same nature as that which *Hydrocera* normally furnishes from without. 2. *On the Arborescent Ferns of New Zealand*; by Thomas S. Ralph:—an instructive, popular account of their trunks and mode of growth. 3. *The Indian species of Utriculariæ;* by Daniel Oliver. Apparently an excellent monograph; the Indian species reduced to about two dozen. 4. *On five New Plants from Peru*; by Richard Spruce.

The botanical contributions to the Journal having much exceeded the zoological in amount, the excess is to be issued in supplemental botanical numbers. The *Supplement to Botany*, No. 1 and No. 2 have appeared, and contain the *Musci Indiæ Orientalis; an Enumeration of the Mosses of the East Indies;* by Wm. Mitten. This paper fills 171 pages, including an index to the species, and introduces some bold reforms in bryology.

4. *Synopsis Hymenophyllacearum, Monographiæ hujus ordinis Prodromus.* Auctore R. B. Van der Bosch, M.D. Leyden. pp. 79, 8vo. A separate impression from the *Nedrl Kruidk Archief*, Dec. 1858.—Dr. Van der Bosch, having in preparation a general monograph of this most elegant group of Ferns, illustrated by figures, has issued this precursory Synopsis. It contains a classified arrangement of the known species, the habitat, most important synonymy, and the characters of a few new species. The two old genera of this group—retained entire by Hooker, but divided into nineteen by Presl,—are here distributed into nine genera, with amended characters; viz:—*Cardiomanes*, Presl, *Feca*, Bory; *Neuromanes*, Trevis; *Cephalomanes*, Presl; *Trichomanes*, Smith (with about 114 known species); *Didymoglossum*, Desv.; *Leptocionium*, Presl; *Hymenoglossum*, Presl; and *Hymenophyllum* (140 species). Carrying his experience as a Bryologist into this analogous field of enquiry, our author finds available specific characters in the cellular structure of the frond. By such characters he distinguishes *Trichomanes brevisetum* from *T. speciosum*, and both from *T. radicanes.* A. G.

5. *The Botany of the Mexican Boundary. Introduction* by C. C. Parry. *Botany of the Boundary*, by John Torrey, M.D. *Cactaceæ*, by George Engelmann, M.D. This forms the first half of that ponderous tome

(almost half as thick as it is wide), the second volume of the *Report on the United States and Mexican Survey* by Col. Emory, and it must be ranked as the most important publication of the kind that has ever appeared. Dr. Parry's interesting Introduction is brief. Dr. Torrey's systematic account of the general botany extends to p. 270, and is illustrated by 61 plates, most of them well-chosen as to the subject, and all admirably drawn by Riocreux, Sprague, and a few by Hochstein. Dr. Engelmann's important memoir on the *Cactaceæ* occupies 78 pages of letter-press and is adorned by 75 plates of surpassing excellence. This and its counterpart, the *Cactaceæ* of the Expedition under Lieut. Whipple (of which Dr. J. M. Bigelow was the botanist), published in the fourth volume of the Explorations and Surveys for a Pacific Railroad Route, and illustrated by 24 plates, elucidate a large, peculiar, and most characteristic order of our wide south-western regions in a manner which must command universal admiration, and must assign to the author a high rank among the systematic botanists of our day. The general Botany of the same expedition, by Dr. Torrey, founded upon one of the best collections ever made in such a journey, and illustrated by 25 plates, is worthy of equal praise.

But all these memoirs are sadly marred by typographical errors. A government printing office is not well adapted for this sort of work, and proof-reading from a distance seems to be ineffectual. The zoological reports are much better printed, doubtless, because the author on the spot could insist upon a sufficient revision of his proofs, and see that his corrections were attended to. The disfigurements which we notice in these are prepense, and are caused by the depraved taste which writes the names of people with a small, instead of a capital initial letter; e. g. *edwardsii*, *clarkii*, *ordii*, *henryi*, and so on, *usque ad nauseum.* Though why they should be so decapitated when genitives after a generic name, although honored with a capital initial when they follow a specific name, passes ordinary comprehension. Consistency would seem to require uniformity like this: *Chordeiles henryi*, baird. Returning to the Botany, with which alone we are at present concerned, we remark that it would have been most convenient and acceptable to botanists to have cited the numbers of Wright's distributed collections throughout, and also, as far as possible those of Fendler, Lindheimer, and of Berlandier's posthumous distribution. A systematic catalogue of all the plants enumerated and described in these various Western Expeditions, or rather a complete catalogue of the species of the United States west of the 100th parallel of longitude, including those of the Mexican border, is now very much wanted. A. G.

6. *Catalogue of the Phænogamous and Acrogenous Plants contained in Gray's Manual of the Botany of the Northern United States, adapted for marking desiderata in exchanges of specimens, etc.* New York: Ivison & Phinney. 1859.—A help of this sort in making exchanges has often been asked for, and the enterprising publishers of Gray's Manual have responded to the demand by publishing, at a low price, this neat Catalogue, for which good office they deserve the best thanks of our scattered botanists. The species are numbered consecutively, from No. 1, *Atragene Americana* to 2421, *Azolla Caroliniana.* The list, in double columns, fills thirty-two pages of the same size as those of the Manual

self. A cent stamp will pay the postage of the pamphlet to any part of the United States; and the sender has only to indicate to his distant correspondent, by marking or by copying the numbers, the species which he desires to receive or is able to furnish. Moreover, the names of the orders, which are printed in bold type, and even those of the genera, may serve another useful purpose: they may be cut out and used for labels in the herbarium. A. G.

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *The Thirteenth Meeting of the American Association for the Advancement of Science* was held August 3–9, 1859, at the City Hall in Springfield, Massachusetts.—The Springfield meeting of the American Association passed off with decided success; the greatest harmony and good feeling prevailed. A large gathering of members from all parts of the United States and Canada and foreign countries enjoyed the graceful hospitalities of one of the most beautiful cities in New England. The number of members in attendance was estimated to be about five hundred. The weather throughout was as fine as possible, and the excursion to Amherst College under the escort of the venerable and distinguished Dr. Hitchcock, was an occasion long to be remembered as one of the golden days of life. Members seemed lost in admiration of the romantic loveliness of the scenery surrounding the College, and in the unexpected extent, richness, and high condition of the scientific collections, unequalled certainly by those of any other college in the United States. Here Dr. Hitchcock has built up a lasting monument of his original labors in the curious department of foot-marks on the Connecticut sandstone. This vast collection, vast both in the numbers and magnitude of its specimens, is now preserved in "Appleton Hall," a new building erected specially for its accommodation, and on the ground floor of which these curious records of lost races once denizens of this lovely valley are spread out to the inspection of visitors. No one can form an adequate notion of the interest of these remarkable collections without a personal inspection.

Whatever the *Black stone* of Mecca may prove to be, meteorite or porphyry, the scientific pilgrim to Amherst will be rewarded by an inspection of the largest and most important collection of meteoric specimens in the world, excepting that of the Imperial Museum of Vienna. By the untiring exertions of Prof. Shepard, 124 meteoric discharges are here represented, in choice and unblemished specimens. The Vienna cabinet is stated in Mr. Haidinger's paper of Jan. 7, 1859, to contain 137 localities.

The mineralogical collection of Prof. Shepard at Amherst is worthy of most particular notice. In the richness and splendor of its selections, the mineral species are nowhere in America and seldom anywhere so well represented. Choice specimens seem to have come to this celebrated collector's hands like the fabled fish of the wierd fisherman. Whatever was most rare or choice from any locality appears to have found no rest until it was safely placed on his shelves.

No wonder then that amid such surroundings and with beauty and festive speech at the hospitable tables covered by the fair hands of Amherst ladies, the Association was beguiled to view the glories of a midsummer sunset over the picturesque ranges of the Northampton hills, or

that they returned to Springfield late in the evening full of the praises of the day and its rich entertainments.

We append a list of the officers of the Springfield meeting, and also of the papers registered.

Officers of the Association, Springfield meeting.—President, Professor Stephen Alexander.—*Vice President,* Prof. Edward Hitchcock.—*Permanent Secretary,* Jos. Lovering.—*General Secretary,* Wm. Chauvenet.—*Standing Committee,* Professors Stephen Alexander, Jeffries Wyman, William Chauvenet, Joseph Lovering, Edward Hitchcock, John E. Holbrook, A. L. Elwyn, Alexis Caswell, W. M. Gillespie, Benjamin Peirce, A. D. Bache, B. Silliman, Jr., Joseph Leconte, Wolcott Gibbs, J. W. Foster, Esq.—*Local Committee,* Hon. George Bliss, *Chairman.*—Dr. George A. Otis, Jr., *Secretary.* R. A. Chapman, Esq., Rev. Francis Tiffany, George M. Atwater, Capt. James Barnes, Samuel Bowles, Ansel Phelps, Jr., Esq., Hon. C. C. Chaffee, Chester W. Chapin, Col. J. M. Thompson, George Walker, Esq., John L. King, Gen. James S. Whitney, Ethan S. Chapin, Josiah Hooker, Esq., A. D. Briggs.—*City Committee,* Mayor William B. Calhoun; Aldermen Roger S. Moore and Horace Smith; Councilmen Gurdon C. Judson, Reuben T. Safford, Joshua M. Harrington, Walter North.

*List of papers registered for presentation to the Association.**

1. On the Origin of the Azoic Rocks of Michigan and Wisconsin; by Charles Whittlesey.

2. On the Drift Cavities, or "Potash Kettles" of Wisconsin; by C. Whittlesey.

3. General Account of the Results of the Discussion of the Declinometer Observations made at Girard College, Philadelphia, between the years 1840 and 1845, with special reference to the Eleven Years' Period; by A. D. Bache.

4. Distribution of Temperature in the Florida Channel and Straits; by A. D. Bache.

5. Comparison of the Amount and Frequency of Rain with different Winds on the Western Coast of the United States; by A. D. Bache.

6. Abstract of the principal results of the Observations of Temperature at Van Rensselaer Harbor, North Greenland, made by the second Grinnel Expedition under command of Dr. E. K. Kane, U. S. N., during the years 1853–4–5; presented by A. D. Bache, from a reduction and discussion by Charles A. Schott, assistant in the Coast Survey.

7. Abstract of the principal results of the Discussion of the Observations for the Direction and Force of the Wind at Van Rensselaer Harbor, North Greenland, made by the second Grinnel Expedition, under the command of Dr. E. K. Kane, U. S. N., in 1853–4–5; presented by A. D. Bache, from a reduction and discussion by Charles A. Schott, assistant in the U. S. Coast Survey.

8. Abstract of the principal results of the Discussion of the Observations for Atmospheric Pressure at Van Rensselaer Harbor, North Greenland, made by the second Grinnel Expedition under command of Dr. E. K. Kane, U. S. N., during the years 1853-4-5; presented by A. D. Bache, from a reduction and discussion by Charles A. Schott, assistant in the U. S. Coast Survey.

9. On the Occurrence of Pot Holes, (or pot-shaped excavations, caused by the gyration of pebbles,) formed by the Drift Agency; by Oliver Marcy.

10. On the marks of Ancient Glaciers, on the Green Mountain Range in Massachusetts and Vermont; by Charles H. Hitchcock.

11. Lake and Pond Ramparts in Vermont; by Charles H. Hitchcock.

* The asterisk prefixed indicate papers not read, and should probably be attached to some others not certainly known to the Editors.

so-called Talcose schist of Vermont; by Charles H. Hitchcock.
of Trachyte and Conglomerate in Shelburne, Vt.; by C. H. Hitchcock.
merate Syenite Porphyry and Granite in Vermont; by Charles H.

Circulation of the Ocean; by Charles Wilkes.
)bservations on Ozone; by John Brocklesby.
ıutions on the subject of Frozen Wells and Cold Springs; by John

ing the Threads of Male and Female Screws, so that they shall com-
rminate at any desired points with precise uniformity and correspond-
us Buckland.
ıod for discharging the Leyden Jar, by employing an Imperfect Con-
. B. Chapman.
Direction, and Progress of Storms in the United States, east of the
ains; by Chester Dewey.
Mass of the Moon; by Stephen Alexander.
tion as to the Earth's Dimensions and Metre; by Stephen Alexander.
' note on Comets; by Stephen Alexander.
Harmonies and the Ancient History of the Solar System; by Stephen

Common Origin of the Asteroids, and also of some of the Comets of
by Stephen Alexander.
Causes of the Variation of Temperature of the Seasons; by G. W.

Theory of the Comet's Tail; by Benjamin Peirce.
History of the Investigation of the Physical Constitution of Comets;
Peirce.
Personal Peculiarities of Astronomical Observers; by Benj. Peirce.
Possible Causes of the observed Geological Changes in the Earth's
; by Benjamin Peirce.
Secular Perturbation of four of the Asteroids; by Simon Newcomb.
Mathematical Theory of Music; by T. H. Safford.
Determination of a Comet's Orbit; by T. H. Safford.
ew method of investigating Plane Curves, with its application to Evo-
ıstics; by William Watson.
teorology; by Joseph Henry.
alysis of the Laws which determine the Action of the Centrifugal Gov-
arles J. Porter.
lian Mode of bestowing and changing Names; by L. H. Morgan.
ches on the Platinum Metals; by Wolcott Gibbs.
ematic Reference Catalogue of all the described North American Lepi-
John G. Morris.
mplete Semicircle of the Zodiacal Light, as seen at night recently by
vers; by George Jones.
casional luminousness of the Atmosphere at night, as observed on the
e Andes; by George Jones.
European Storm of Dec. 25, 1836; by Elias Loomis.
alleged Lunar Origin of Aerolites; by B. A. Gould, Jr.
ı occurrence of bones and teeth in the lead-bearing crevices of the
ıy J. D. Whitney.
ain Curves treated by new Coördinates; by Thomas Hill.
Scope and Method of Linguistic Science; by W. D. Whitney.
ı Arts which distinguish Nations of the Eastern World from the Abo-
ı Western Continent; by J. H. Gibbon.
an Corn (*Zea Mays*) a native of three continents, like Cotton and To-
H. Gibbon.
of the Southern Hemisphere; by James H. Coffin.
Hindu Astronomy; by W. D. Whitney.
Lasso-Cells of Polypi and Acalephæ; by H. J. Clark.
Facetted Eyes of Acalephæ, especially of *Aurelia flavidula;* by H. J.

53. On apparent equivocal Generation; by H. J. Clark.
*54. On a supposed Meteorite of a new Chemical Constitution from North Carolina; by C. U. Shepard.
*55. On an Examination of the Matter of a supposed Shooting Star that fell on the eve of November 16th, 1857, at Charleston, S. C.; by C. U. Shepard.
56. Vibrations in the Water-fall at Holyoke, Mass.; by E. S. Snell.
57. System of Consanguinity of the Red Race, and its relations to Ethnology; by Lewis H. Morgan.
58. On a Frozen Deposit of modified Drift in Brandon, Vermont; by Edward Hitchcock.
59. On the Conglomerate near Newport, R. I., with elongated pebbles and transverse joints; by Edward Hitchcock.
60. On a Deposit of Fossiliferous Limestone beneath Granite and Mica slate in Derby, Vermont; by Edward Hitchcock.
61. An attempt to prove that the younger Metamorphic Rocks have been in a plastic or semi-plastic state since their original consolidation; by E. Hitchcock.
62. On the Amount and Proofs of Erosion in Vermont, with special reference to Peaks of protrusive rocks; by Edward Hitchcock.
63. Recent Discoveries in the Devonian and Carboniferous Flora of British America; by J. W. Dawson.
64. The means of preventing the Alteration of Metallic Surfaces employed to close and break a voltaic circuit; by F. A. P. Barnard.
65. On the sudden Disappearance of the Ice of our Northern Lakes; by J. G. Totten.
66. On Nitride of Zirconium; by J. W. Mallet.
67. On the Atomic Weight of Lithium; by J. W. Mallet.
68. On Osmious Acid, and the position of Osmium among the Elements; by J. W. Mallet.
69. On the Vertical Planes in Bituminous and other Coals; by E. B. Andrews.
70. On the Terraces along the Rivers in Southern Ohio; by E. B. Andrews.
*71. On the Zoomorphic Sandstone of the Connecticut Basin; by Joseph Barratt.
*72. On the Discovery of a Creature (*Kamdactylus sub-humanus*), the Antetype of Man; by Joseph Barratt.
73. Ornithichnites; by Roswell Field.
*74. On the Geometrical Construction of Curves of degrees higher than the second, having given multiple points; by H. A. Newton.
75. The Correlation of Physical, Chemical and Vital Forces, and the Conservation of Force in Vital Phenomena; by Joseph Leconte.
76. On the Formation of Continents and Oceans; by Joseph Leconte.
77. Observations on the Geology of the Rocky Mountains in the vicinity of Santa Fe, New Mexico; by William P. Blake.
78. Physical Constitution of Comets; by W. A. Norton.
79. On the alleged occurrence of Sand in Maple Sugar; by E. N. Horsford.
80. On the Source of Carbonate of Lime in Organic Structures occurring in Sea-water; by E. N. Horsford.
81. On some recent Determinations of the Carbonic Acid in the Waters of the Congress Springs of Saratoga; by William E. Hughes, presented by E. N. Horsford.
*82. Some experiments made at the Lawrence Scientific School, on the heating powers of luminous and non-luminous Flames; by G. A. Gould, presented by E. N. Horsford.
*83. On the Prevention of Fermentation in the Juices of Fruits, by means of Sulphite of Lime; by E. N. Horsford.
84. Theoretical Explanation of the similarity between the Flora of Northeastern Asia, and that of Eastern North America; by Asa Gray.
85. Note on the Discharge of Atmospheric Electricity through Gas Mains; by Benjamin Silliman, Jr.
*86. On the application of Electric Conductors to Buildings; by L. F. Locke.
87. Remarks on the Restored Skeleton of the Fossil Whale of Charlotte, Vt.; by Edward Hitchcock, Jr.
88. On some applications of the principle of Relative Motion to the determination of the Areas of Closed Curves; by George Eastwood.

89. On the use of a Transit-Circle as a substitute for the Zenith Telescope in the determination of Latitude; by C. S. Lyman.
90. Instruments for measuring the Depth of the Ocean; by W. P. Trowbridge.
91. On the Stratigraphical Position of the Sandstone of the Connecticut Valley; by J. D. Whitney.
92. On a remarkable Vein of Gold in the bed of the Chestatee river, Georgia; by W. P. Blake.
93. The Placer Gold Mines of Georgia, and the introduction of improved methods of working them; by W. P. Blake.
94. Remarks on the Minerals and Ancient Mines of the Cherokee Valley River, North Carolina; by W. P. Blake.
95. Contribution to the History of the Laurentian Limestones; by W. E. Logan.
*96. On "Anhydrous Fermentation;" by L. F. Locke.
97. On some Reactions of the Salts of Lime and Magnesia; by T. S. Hunt.
98. On the Paradox of the Coexistence of Excessive Production and Excessive Population; by Clinton Roosevelt.
99. On the Formation of Gypsum and Magnesian Rocks; by T. S. Hunt.
100. On the Origin and Formation of Silicious Rocks; by T. S. Hunt.
101. The Relations of the Upper Carboniferous Rocks of Illinois to the older members of the Palæozoic System; by J. H. McChesney.
102. Remarks on the Discovery of a Terrestrial Flora in the Mountain Limestone of Illinois; by A. H. Worthen.
103. On the Composition of Pectolite; by J. D. Whitney.
104. On Magnetizing Locomotive Wheels by Curved Helices, and the Experimental Results; by Edward W. Serrell.
105. Vital Observations and Statistics as Data for the Formation of Natural Life-Tables; by E. B. Elliott.
106. Experiments on Induction-Time in Electro-magnets in Telegraph Lines; by A. D. Bache and J. E. Hilgard.
107. On Certain Phenomena of the Great Dismal Swamp in Virginia and North Carolina; by Nathan B. Webster.
108. The Causes of Steam-boiler Explosions; by James Hyatt.

The officers of the Association for 1860 are: President, Isaac Lea, of Philadelphia; Vice President, B. A. Gould, Cambridge, Mass.; General Secretary, Joseph LeConte, of Columbia, S. C.; Treasurer, A. L. Elwyn, of Philadelphia.

The next meeting will be held at Newport, R. I., on the first of August, 1860. The warm waters of that shore will offer a rich treat to the naturalists who will unquestionably assemble at Newport in unwonted numbers.

The address of the retiring president, Prof. Alexis Caswell of Brown University, after paying a deserved tribute to the memory of deceased members, was a sketch of American progress in his favorite science of Astronomy. It will be published in the Transactions of the Association.

Among the attractions already visible for the Newport meeting will be—by appointment of the Association—a discourse by Prof. Joseph Henry, commemorative of the life and scientific labors of Dr. Robert Hare; and an address by A. D. Bache on the Gulf Stream. It is equally interesting and appropriate that the labors of his great grandson should have contributed so signally to enlarge our knowledge of this wonderful river of the sea, which Dr. Franklin was the first to bring to the general notice of the scientific world. Dr. Jos. Leidy was also requested to address the Association at Newport upon the extinct Reptilia and Mammalia of North America.

2. *Scientific versus Practical Instruction.*—The following testimony of Liebig as to his famous school at Giessen, is worth considering in these days of schools of practical science.

"The technical part of an industrial pursuit can be *learned*: principles alone can be *taught*. To learn the trade of husbandry the agriculturist must serve an apprenticeship to it; to inform his mind in the principles of the science he must frequent a school specially devoted to this object. It is impossible to combine the two; the only practicable way is to take them up successively. I formerly conducted at Giessen a school for practical chemistry, analysis, and other branches connected therewith, and thirty years' experience has taught me that nothing is to be gained by the combination of theoretical with practical instruction. It is only after having gone through a complete course of theoretical instruction in the lecture-hall that the student can with advantage enter upon the practical part of chemistry. He must bring with him into the laboratory a thorough knowledge of the principles of the science, or he cannot possibly understand the practical operations. If he is ignorant of these principles, he has no business in the laboratory. In all industrial pursuits connected with the natural sciences, in fact, in all pursuits not simply dependent on manual dexterity, the development of the intellectual faculties by what may be termed school learning, constitutes the basis and chief condition of progress and of every improvement. A young man with a mind well stored with solid scientific acquirements will, without difficulty or effort, master the technical part of an industrial pursuit; whereas in general, an individual who is thoroughly master of the technical part may be altogether incapable of seizing upon any new fact that has not previously presented itself to him, or of comprehending a scientific principle and its application."—*Liebig, Letters on Modern Agriculture, edited by John Blyth, M.D.*

3. *Dr. Newberry's late Explorations in New Mexico—he shows Marcou's so-called Jurassic to be Cretaceous.*—Advices have been received from Dr. Newberry at Santa Fé, N. Mexico, as late as July 18th, in letters to Mr. Meek. Dr. N., following the Santa Fé road from Independence, Mo., to near Burlingame, Kansas, saw nothing but rocks of the upper Coal measures, but near Burlingame, on the banks of Dragon creek, he found the first Permian forms [the dip in all this region is N.W.] From Wellington to Cottonwood and Turkey creek the Permian was constantly found in the hill-tops, but the valleys were excavated down to the Carboniferous. The Permian was a light cream-colored Magnesian Limestone. From the Little Arkansas to Walnut creek the surface rocks were Red, Yellow and White Marls and Gypsum, so characteristic of the Llano Estacado and the country west of the Rio Grande. There were no fossils. These are the beds seen by Meek and Hayden and described by them as between the lower Cretaceous and the Permian in Kansas, some 35 to 40 miles farther to the northeast, and which rocks they state in their paper may be either Jurassic or Triassic—but they (like Dr. Newberry) discovered no fossils in them.

On the banks of Walnut creek, a tributary of the Arkansas—a little farther west, Dr. Newberry saw the same red or brown sandstone from which Messrs. Meek and Hayden collected the fossil leaves on Smoky Hill

river, some 40 or 50 miles farther to the northeast, and also in Nebraska at the Blackbird Hills. In this sandstone and in a gray clay beneath it, he also has found some of the same "leaves of dicotyledonous trees—Willows, &c., precisely as at Smoky Hill, Blackbird Hills and in New Jersey." These leaves Dr. Newberry pronounces the same which mark the base of the Cretaceous in New Jersey, Nebraska and Kansas. These are the leaves declared by Prof. Heer and Mr. Marcou to be *Miocene!*

The Cretaceous beds at this point were not seen by Dr. Newberry overlying the sandstone, but on the Canadian, further southwest, as we might expect from the dip, he found this *same sandstone overlaid by the same Cretaceous seen by Meek and Hayden surmounting it in Nebraska.* In these Cretaceous beds,—a whitish marly limestone and shale (Nos. 2 and 3 of the Nebraska Section of Meek and Hayden, the Sandstone being No. 1,)—he found *Inoceramus problematicus*, a well known Cretaceous species (so in England and various parts of Europe,) as well as in No. 3 of the Nebraska Section,—associated with *Ammonites New-Mexicana*, *Gryphæa Pitcheri* (*G. dilatata*, var. *Tucumcarii* of Marcou). Thus we have the same stone which Mr. Marcou and Prof. Heer would make *Miocene*, *overlaid* by beds containing not only well known and admitted Cretaceous fossils, but along with these the very *Gryphæa* relied upon by Mr. Marcou for the establishment of the existence of the *Jurassic*. So if Mr. Marcou and Prof. Heer are right, the Miocene proves to be older than the Cretaceous and the Jurassic! and the unfortunate American geologists find to their confusion that the roof of their geological edifice was constructed before the foundation was laid.

Dr. Newberry states also, "at Galisteo I found upper and lower Cretaceous rocks beautifully exposed, and in the *lower Cretaceous Sandstone* (Jurassic of Marcou) *dicotyledonous leaves.*" "The [true] Jurassic may be in New Mexico," he continues, "but we have not yet detected it—Marcou's Jurassic is certainly not so."

The facts elicited by Dr. N. seem however to sustain the Trias in New Mexico. Writing from Abiquia (near Santa Fé), N. Mexico, he says: "Here in the red gypsum-bearing marls—the 'Gypsum formation' of Blake, and the 'Marl Seams' of Dr. N.'s former report he finds extensive deposits of copper—copper schists and copper conglomerate, precisely as the copper schists of Europe." The red gypsum-bearing rocks here referred to as embracing the copper schists are probably the same seen by Meek and Hayden in Kansas between the Permian and the Lower Cretaceous, and which they were disposed to refer to the Jurassic or Triassic.

The most important evidence however, of the age of these deposits, is in the occurrence in them of Cycadaceous plants—*Zamites*, *Pterophyllum*, &c., which are, in Dr. N.'s opinion, similar to those of the Keuper (Upper Trias) of Europe; but he reserves a positive assertion on this point until he can compare his New-Mexican forms more carefully with the European species than is possible in the field.

Dr. Newberry's route lay from Abiquia, the day after his latest date (July 18th) towards the country near the mouths of the San Juan, which, from all accounts, is a paradise for the geologist, but very much the reverse for other people. He hopes to exhibit his interesting collections to his geological friends in the United States by the end of October.

4. *Meteor of August* 11, 1859.—On the morning of the 11th of August, at 7 o'clock and 20 minutes, or thereabouts, thermometer 73° F., air still and without clouds, two violent and successive explosions or reports (one witness, Mrs. Ball, says there were three,) were heard over a district of country, extending in an east and west line, from Blandford, in Hampden county, Massachusetts, to some ten miles west of the cities of Troy and Albany on the Hudson—a distance of about 100 miles;—and in a north and south line from Bennington, Vt., to Columbia Co., N. Y., a distance of about 80 miles.* The noise, which has been compared by some, to two successive, sharp and heavy peals of thunder, and by others, to the report occasioned by the explosion of a steam-boiler, or powder-mill, was accompanied by very distinct and prolonged echoes, and appears to have been noticed most sensible, and to nearly an equal degree, in Troy, Greenbush, Lansingburg, Waterford, Grafton, and New Lebanon, in N. Y., at Bennington in Vermont, and in the vicinity of Pittsfield, Mass. At Troy, the concussion was so great that houses were shaken, and people walking in the streets were conscious of a vibration of the earth. At Schaghticoke, N. Y., and Bennington, Vt., where powder-mills are in operation, the report was referred by the citizens to explosions at the works. At Schaghticoke, when the managers of the powder-works ascertained that no explosion of mills had taken place either in their own town or in Bennington, they at once concluded that a train of waggons despatched from their works for Troy, a few hours before, with powder had been blown up, and messengers were sent with haste in pursuit of them. At Eagle Bridge, on the Troy and Bennington railroad, the concussion was forcible enough to jar the windows and shake the seats in a train of cars in motion. At Schodack, on the Springfield and Albany railroad, men who were at work in the fields heard the report and felt the shock with great distinctness, and at Greenbush, a large number of people rushed to the docks, expecting that a steamboat had burst its boiler.

As to the cause of the phenomenon;—a great abundance of concurrent testimony, seems to prove, that it was due to the explosion of an immense meteor at a considerable distance above the surface of the earth. This evidence, so far as we have been able to collect it is, as follows:—

John P. Ball, County Clerk of Rensselaer Co., N. Y., in a letter to the editor of the Troy Times, states: "that as he was standing in his door-yard, just after breakfast, he observed a bright body in the air, descending very rapidly to the ground in a northwesterly direction. When apparently about a half a mile above the earth, it disappeared, and in a moment or more he heard the explosion. It was very loud and resembled thunder. He had previously called his family to view the meteor, and they all observed the light and heard the explosion. Mrs. Ball insists that there were three separate explosions—one much louder than the others—and in support of her statement, Mr. B. says he saw three distinct clouds of smoke in the track of the meteor, which appeared to be a mile or more apart. The smoke was visible for some time, but was finally lost to sight. The meteor appeared to be at a distance of about twenty miles from Mr. Ball's residence."

* The limits, as here given, are based upon positive information; they may, however, possibly have been much more extensive.

Ezra Turner and son, of North Schaghticoke, N. Y., three miles north of Mr. Ball's residence in Grafton, observed the meteor distinctly, and heard the explosion.

At New Lebanon, N. Y., it was seen by two members of the Shaker community to pass over their town in the direction of Troy, and was apparently as large as a "flour barrel."

At Hoossic, N. Y., it was also observed, together with the cloud of smoke that followed the explosion. A lad living in the easterly limits of the city of Troy, N. Y., saw a ball of fire in the air, and called his family to look at it. As he did so the extraordinary report was heard, and those who looked in the direction he indicated, saw a small but dense cloud of smoke.

Under date of Aug. 13th, 1859, J. R. Simmons of Berlin, N. Y., writes to the editor of the Troy Whig, as follows:—"I was standing in front of my house on Thursday morning, the 11th inst., at 7 o'clock and 20 minutes,—there being a cloudless sky or very nearly so,—when my attention was suddenly attracted upwards. I saw a meteor of gigantic size, passing between the perpendicular and the altitude of 65°, towards the southwest, in a horizontal line, with great velocity, remaining in sight several seconds, and leaving trails of smoke at intervals. The color was red, like lights thrown from a roman candle, and had connected with it all the rainbow hues. While it was passing in sight I remarked to the Rev. J. D. Rogers and my family, 'there's a rocket;' they did not get to the door before it had passed out of sight, leaving nothing but the trails of smoke for them to see. While we were looking at these, I remarked to Mr. R., that I had never seen a meteor previous to this, without hearing sound produced like a fireball in its flight through the air, or like the report of a fowling gun when discharged. After the lapse of five minutes we all heard the [qu. *three?* Eds.] heavy peals, more terrible than thunder, jarring the earth as well as the atmosphere. I have heard so many conjectures in relation to what produced the terrific report, and most of them so remote from the real cause, that I have given you a correct description of the whole scene that has caused so many remarks."

At Livingston, Columbia Co., N. Y., the meteor was observed in the north, "*with strips of apparent smoke, and a long rumbling sound.*"

Under date of August 18th, 1859, Emory F. Strong of South Manchester, Connecticut, writes to the editors of the Hartford Courant as follows:—"About twenty minutes before eight o'clock on the morning of the 11th, I was standing with a friend in a position facing the northern horizon, when our attention was attracted by an unusual appearance in the heavens—a luminous body, equal to the sun in brightness, was seen about ten degrees west of the meridian, and passing rapidly in a westerly direction; when within apparently twenty degrees of the horizon it disappeared for an instant and then on reappearing seemed to explode. Its last appearance was not unlike that of a large sky-rocket in the act of explosion. We listened for the report but heard none. The sun was shining brightly at the time, which would have rendered the phenomenon invisible to all except those whose attention for the moment happened to be directed to that particular portion of the heavens."

A correspondent of the N. Y. Evening Post, writing from New Lebanon, N. Y., gives the following account of this phenomenon as observed

in that vicinity:—"About 7 o'clock on that morning as I was about to leave my bed chamber, I was startled by two distinct and very heavy explosions, so that I immediately ran to the window and looked over toward the Shaker village hill, where I knew they were blasting stones to build the great dam in that village, but could see no smoke at all, the sky being clear and the weather beautiful. The noise was so startling as to call the attention of every one about the premises, and various persons in our house (a large farm house) went out of doors, and others to the window, to see what was the matter. The *house trembled* so as to be noticed by all of us—a family of over twenty people, and more than half were in the house at the time.

"We supposed some powder mill had exploded, but heard during the day that two of the 'Shakers,' Messrs. Calvert and Chase, (two miles from here,) who were out in the field, had their attention drawn to a bright light in the sky, when they saw a meteor, which exploded apparently in the vicinity of Pittstown, and immediately the great report followed. They were looking north, while my window looked south, but I might not have seen the meteor if I had looked north, as the two 'Shakers' were on a high hill, while I was in a valley. [This fully confirms Mr. Ball's account].

"My brother, with three others of our family, was riding in a carriage, on his way to Canaan to meet the cars, at the time of the explosion, and the noise was so great as to excite remarks from all in the carriage, and to make both the horses jump as though frightened. The noise was heard at all the neighboring villages, and resounded through the valleys and hills like very heavy thunder. It was heard at 'Columbia Hall,' at Lebanon Springs, one and a half miles from here, but not so distinctly as we heard it, as the explosion occurred north of us, and that hotel stands on the south side of a high hill."

From Morristown, Lamoille county, Vermont, twenty-five miles north of Montpelier, Mr. J. M. Chatterton writes, that the meteor was seen at the same time as noticed elsewhere, by himself and others. "The sun was shining brightly at the time, and its course was towards the south."

"A Subscriber" writes to the Boston Journal from "Copperas Hill," Strafford, Vt., confirming the accounts from Troy. He says:—"The same phenomenon was witnessed from this place by two gentlemen who were making investigations in the extensive mines of copper, iron, &c., to be found here. At the same hour above mentioned, their attention was suddenly attracted by a very brilliant object descending in a southwesterly direction, and resembling very much one portion of what is called golden rain in a rocket, only many times larger, and followed by a long train of light. Although the sun was shining brightly, still so intense was the brilliancy of this meteor, or whatever it might have been, that it had the appearance of not being over half a mile off, and we were fully expecting to feel the effects of some great explosion; but its distance was so much greater than we had apprehended, that no shock was experienced."

The Albany Evening Journal of Aug. 20th has the following item:—"Garritt Vanderpool, a well-known and highly respected farmer, lives seven miles from this city, and one mile west of the Bethlehem church. When at work in his barn, on the morning of the mysterious commotion heretofore referred to, and about two minutes after the noise which had attracted his attention had ceased, he heard what sounded like a small

stone thrown against the side of his carriage-house. On looking up, he saw the object fall, and at once picked it up. It is about the size of a pigeon's egg, broken through the centre; and is partially covered with a black substance. Mr. V. says there is no stone on his farm like it, and is fully persuaded that it is a part of the exploded meteor. Others also think so. It will be examined by competent judges, and the result properly announced."

The above seem conclusively to establish the fact that a meteor of great size passed into our atmosphere on the morning of the 11th of August and exploded with great violence, throwing down stones to the earth. It would even seem possible, from a comparison of these facts, to deduce its mass, velocity and apparent motion.

In this connexion we would recall the familiar history of the remarkable meteor which exploded over Weston, Conn., on the morning of December 14th, 1807, as described by Profs. Silliman and Kingsley.* In that case there were three distinct and violent explosions, each followed by a discharge of meteoric stones, specimens of which from each locality were subsequently obtained. Let us hope that a diligent search for the relics of the Troy meteor will be in like manner rewarded, and the results duly reported.—[D. A. Wells, Esq., of Troy, N. Y., has kindly sent us most of these facts.—Eds.]

Bibliographical Announcements.

5. *Address at the Anniversary Meeting of the Royal Geographical Society* (23d May, 1859); by Sir Roderick Impey Murchison, G.C.St.S., D.C.L., F.R.S., President. London, Cowles & Sons. 8vo, pp. 132.—This Address is full of interesting notices of the lives and services of illustrious members of the Geographical Society deceased during the year.

6. *Elements of Mechanics for the use of Colleges and Academies;* by William G. Peck, Adjunct Professor of Mathematics, Columbia College. New York. A. S. Barnes & Burr. 12mo. pp. 338. 1859.—This work embraces all the important propositions of elementary mechanics, arranged in logical order and each rigidly demonstrated. It fills an important hiatus in our elementary works and in the hands of a good teacher will be highly esteemed.

7. *Annual Report of the Director General of the Geological Survey of the United Kingdom; the Museum of Practical Geology, &c.* 24 pp. 8vo, with 4 progress maps.—This is the annual report showing the progress made in the several important scientific trusts comprised in the Jermyn St. establishment now under the general direction of Sir R. I. Murchison.

8. *Experimental Researches relative to Corroval and Vao; two new varieties of Woorara, the South American Arrow-Poison;* by William A. Hammond, M.D., Assist. Surgeon U. S. Army and S. Weir Mitchell, M.D., Philadelphia. Read before the Academy of Nat. Sci. Philad., May 16, 1859. [*Brochure*, Extracted from the Am. Jour. Med. Sci., July, 1859.] pp. 48.

9. *Astronomical and Meteorological Observations made at the Radcliffe Observatory, Oxford, (Eng.)* in the year 1857, under the superintendence of Manuel J. Johnson, M.A., Radcliffe Observer. Vol. xviii. Published by order of the Radcliffe Trustees. Oxford, J. and J. Parker. 1859. 8vo. pp. 255 Astronomical, 132 Meteorological. 7 plates.

* Memoirs Connecticut Academy of Arts and Sciences, vol. i, pp. 141 (1810.)

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A Manual of Spherical and Practical Astronomy, embracing Nautical omy, and the theory and use of fixed and portable Astronomical Instrum ply illustrated by engravings on wood and steel. By Prof. WILLIAM CHA of the United States Naval Academy. In two royal octavo volumes. Pric

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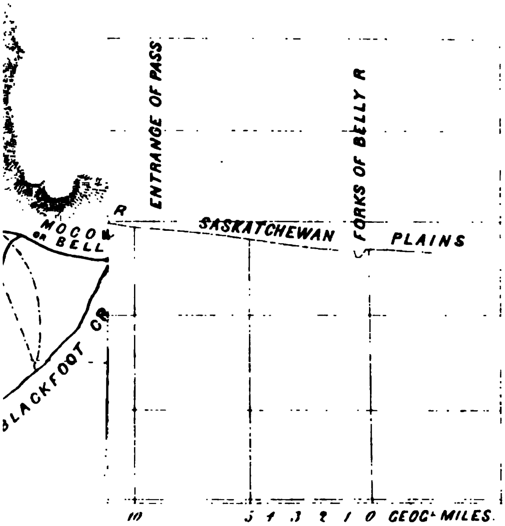
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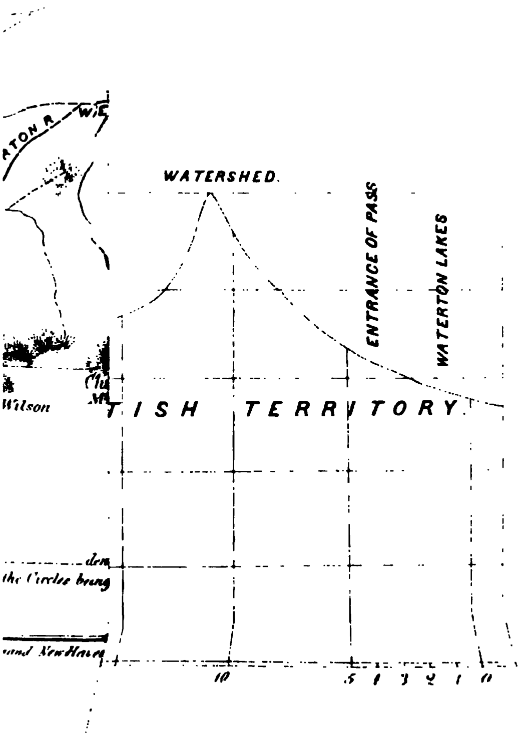
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[SECOND SERIES.]

XXXIV.—*The Correlation of Physical, Chemical and Vital* *e, and the Conservation of Force in Vital Phenomena;* by EPH LECONTE, Professor of Geol. and Chem. in the South olina College, Columbia.

efore the American Association for the Advancement of Science, at the Springfield Meeting, August, 1859.)

TTER constantly changes its *form*—but is itself indestructi- cept by the same power which called it into being. The uantity of matter exists in the universe at all times. So also hanges its *form* constantly, but is itself indestructible, inca- of increase or diminution, and the same absolute amount e exists in the universe at all times and forever. The mu- nvertibility of the various forms of force is called "correla- forces." The invariability of the absolute amount in the of constant change is called "conservation of force." This le of correlation and conservation of force must be looked s one of the grandest generalizations in modern science, ciple startling at first, but when clearly understood and grasped, almost axiomatic. It must be considered a ary truth, and as such is a legitimate basis of deductive ing.

correlation of *physical* forces is universally recognized as iple in science, and not only so but has already been pro- e of many beautiful and useful *results;* but the correlation sical and *vital* forces while generally recognized as a

probable fact has only been speculated on in a vague and as yet unfruitful manner. The science of life is scarcely yet ripe for the legitimate extension of this principle over its domain. The most elaborate attempt of this kind which I have seen, is contained in the very remarkable and suggestive paper of Dr. Carpenter entitled "mutual relation of physical and vital forces," and published in Phil. Trans. for the year 1850.

In the present paper I wish simply to present a few thoughts, which have originated in my own mind, in the course of reflection on this subject, in the hope that they may prove suggestive to others. They have at least the merit of being uninfluenced by the writings of others—and therefore perhaps of presenting the subject in a somewhat new light. I sincerely wish I could present the matter in a more definite form, but it is certain that where a subject is not perfectly understood, the attempt to give our ideas more definiteness also makes them more questionable. We are obliged to be content with a certain vagueness, in the hope that by the use of right methods a clearness will come after. We must gratefully accept the twilight in the hope that it marks the approach of the full light of day.

There are four planes of material existence which may be regarded as being raised one above the other. The *first* and lowest is the plane of elementary existence, the *second* the plane of chemical compounds, or mineral kingdom, *third*, the plane of vegetable existence and *fourth*, of animal existence. Now it is apparently impossible for any known force in nature to raise matter through all these grades at once. On the contrary there is a special force adapted for the elevation of matter from each plane to the plane above. It is the special function of chemical affinity to raise matter from plane No. 1 to No. 2. All the changes too which take place upon plane No. 2 by the mutual reactions of bodies situated on that plane, are under the guidance and control of this force. It is the special prerogative of the force of vegetation—of vegetable life, to lift matter from No. 2 to No. 3, i. e., from the condition of mineral matter to the higher condition of vegetable matter. All the changes which take place upon this plane, the laws of which constitute vegetable physiology, are under the guidance of this force. Finally, the force of animal life and that alone enjoys the privilege of lifting matter still higher into the 4th plane, i. e., the plane of animal existence. No force in nature can lift from No. 1 to No. 3, or from No. 2 to No. 4. Plants cannot feed entirely upon elementary matter, nor can animals feed upon mineral matter. The reason of this will be seen in the sequel. Thus it seems that after matter is raised from the elementary to the mineral condition, it requires an additional force of another and peculiar kind to raise it into the vegetable kingdom, and again another accession of force to raise it into the animal kingdom. These kingdoms are, there-

fore, truly represented as successive planes raised one above the other, thus:

No. 4, *Animal Kingdom.*
3, *Vegetable Kingdom.*
2, *Mineral Kingdom.*
1, *Elements.*

If then it be admitted that this is the relative position of these planes—that it requires a greater and greater expenditure of force to maintain matter upon each successive plane, then it follows *that any amount of matter returning to a lower plane by decomposition must set free or develop a force which may under favorable circumstances raise other matter from a lower to a higher condition.* Or to express it by a mechanical illustration, a given amount of matter falling from one plane to any plane below, develops a force sufficient to raise an equal quantity of matter an equal height. Thus *decomposition* must in every case *develop force*, which force may take the form of heat as in combustion, or electricity as in electrolysis, or may expend itself in forming chemical compounds or *even in organizing matter.*

Again, in the same manner as matter may be arranged in several distinct and graduated kingdoms, so it seems to me the forces of nature may also be properly divided into distinct groups arranged in a similar manner one above the other. These are the *physical*, the *chemical* and the *vital* forces. And as in the case of matter so also in the case of *force*, it is impossible to pass directly from the lowest to the highest group without passing through the intermediate group. The conversion of *physical* into *vital* force seems impossible without passing through the intermediate condition of *chemical force.*

These are the simple principles upon which are based all that follows—principles which may possibly seem fanciful to some unfamiliar with the principle of conservation of force, but the number of phenomena which they consistently explain will I hope entitle them to serious thought.

1st. It is well known that chemical elements, in what is called the "nascent condition" i. e., at the moment of liberation from previous combination, exhibit a peculiar energy of chemical affinity not exhibited under other circumstances. It seems to me that this is readily explicable on the principle of conservation of force. At the moment of decomposition the chemical affinity which bound the elements together and which was before satisfied, is suddenly left unsatisfied. There is an attraction *set free* which was before *disguised*—a force *liberated* which was before *latent.* If conditions favorable are present this force may preserve the form of chemical affinity, and expend itself in forming other chemical compounds; or even, as we shall see hereafter, in organizing matter. But if favorable conditions are not

present, then it may take some other form of force, e. g., heat or electricity, and *therefore no longer exist as chemical affinity.* The chemical affinity is said to be lost. To return to the mechanical illustration used above. Matter falling from plane No. 2 to plane No. 1 develops force sufficient to raise *other matter* from plane No. 1 to No. 2, but which in the absence of such matter may expend itself in heat or electricity or some other form of physical force.

2nd. It is a fact, now well established, that the *seed* in germination forms carbonic acid, and in doing so loses weight. That is, the organized matter of the seed is *partially decomposed*, a portion of its carbon uniting with the oxygen of the air to form carbonic acid. Now it is this *decomposition* which develops the force by which germination is effected. A portion of the organic matter of the seed is *decomposed.* This decomposition sets free a force which suffices to organize the rest. The force necessary and therefore the amount of decomposition necessary in this case is small because the work to be accomplished is simply the change from one form of organic matter to another, or rather from *organic* to *organized* matter—to recur again to the former illustration, merely shifting a certain quantity of matter from one place to another upon the plane No. 3. "But how," it may be asked, "is this decomposition brought about?" This seems to be effected by the heat and perhaps (according to Hunt) by the actinic rays of the sun.* Heat and actinic rays have been spoken of by many writers, e. g., by Carpenter and by Robert Hunt as the physical force which is changed into organizing force by means of the "substratum of an organized structure:" but the peculiarity of the view which I now present, is that this conversion does not take place *immediately*, but only *through the mediation of another force more nearly allied to the vital*, viz: *chemical force.* The food is laid up in the seed mostly in the form of starch. In the act of germination this starch is changed into sugar. Starch as is well known differs from sugar in two important respects, viz., it is *insoluble* and it is more *highly carbonized.*† Now according to the ordinary view, the only object of the partial decomposition is to change the food from an insoluble to a soluble form—and this can be done only by elimination of a portion of the carbon in the form of carbonic acid. According to the view which I now present, *the food is always laid up in a more highly carbonized condition than is wanted, in order that force may be set free by elimination of superfluous carbon.* According to the ordinary view, if an insoluble food could be found, capable of conversion into the soluble form, without loss of car-

* See Report by Robert Hunt on the growth of Plants, Rep. Brit. Assoc., 1846, p. 33, 1847, p. 80.

† Robert Hunt, Rep. Brit. Ass., 1847, p. 20–22. Carpenter, Comp. Phys., p. 288. Mülder, Chem. An. and Veg. Phys., pp. 208, 280.

hen germination of the seed might take place without weight, by the direct conversion of heat into vital force. ling to my view, *decomposition* and therefore *loss of weight,* *utely necessary to develop the organizing force*, the loss of being in fact the exact measure of that force.

As soon as the plant develops *green leaves*, a complete takes place in its mode of development. It no longer eight but increases in weight. It not only develops but The reason of this is, that the organizing force is no developed by decomposition of food laid up within its ssues, but by the decomposition of food taken *ab externo.* ht is universally admitted to be the physical force con- in this decomposition. Farther, it is generally supposed iere is a direct and immediate conversion of light into orce in the green leaves of plants. But evidently this is ible, since the *work done by the light is the separation of the nents carbon and oxygen.* Light is therefore converted into . It is therefore the chemical affinity thus set free which force immediately converted into vital force. The food of consists of carbonic acid, water and ammonia (CO_2, HO H_3,) or in some cases according to M. Ville of CO_2, HO .* Sunlight acting through the medium of the green of plants has the remarkable power of decomposing CO_2. *orce thus set free from a latent condition*, or the chemical of *carbon in a nascent condition* is the force by means of C, H, O and N are raised to the organic condition.† To to my former illustration; matter (oxygen) falling from ond to the first plane develops force sufficient to raise matter from the second to the third plane. Thus it is tly *impossible on the principle of conservation of force that should feed entirely upon elementary matter;* whereas ac- g to the ordinary view of the direct conversion of light rganizing force, there is no reason why plants should not ntirely on elements, except that one of them, carbon, is ble.

There are many other phenomena of vegetable life which e a ready explanation on this theory. I have said that ht has the power of decomposing carbonic acid only in the eaves of plants. *Pale plants*, such as the Fungi among gams and the Monotropa among phænogams, have no to decompose CO_2. These plants, therefore, cannot feed

e review of the controversy between Boussingault and Ville on this subject, iv. Arch. des Sci., vol. 30, p. 305. Also Phil. Mag., 4th ser., vol. 13, p. 497. s Sci., 4th series, vol. 2, p. 357. Am. Jour. Science, vol. 19, p. 409. Bib. rch. des Sci., vol. 28, p. 335. Ann. des Sci., 4th series, vol. 7, p. 5.

nmonia is also probably decomposed in the tissues of the leaves of plants, ter, correlation of physical and vital forces. Phil Trans., 1850, p. 782. See rren, Bib. Univ. Arch. des Sci., new period, vol. 5, p. 84). This would of produce additional organizing force.

upon chemical compounds—mineral matter. They ***must feed upon organic matter***, which organic matter ***in its partial decomposition furnishes the force necessary for organization.*** If so, then this decomposition, as in the case of germination, must be attended with the elimination of CO_2. Both of these are known to be facts. Pale plants do feed upon organic matter and do evolve CO_2. The necessary connection of these facts with one another and with the principle of conservation of force, is now for the first time, as far as I know, brought out. The phenomena of nutrition in these plants is similar to that of seeds in germination, except that the latter contains the organic matter already laid up within its own tissues, while the former derives it from decaying vegetable or animal matter taken *ab externo* into its tissues. In this case too, as in germination, heat is apparently the physical force which effects the decomposition of the organic food, and which is therefore converted indirectly through chemical into vital force. Light is actually unfavorable to this process, for light tends to decompose, not to form CO_2. In both cases therefore the conditions favorable for nutrition are first, abundance of soluble organic matter, second, absence of light and presence of heat. This is then apparently the true reason why germinating plants and pale plants avoid the light. These plants grow by the *oxydation* of carbon and formation of CO_2. Light *decomposes* CO_2 and must therefore be antagonistic to its formation, and consequently to the growth of these plants. Whether or not this property of light is entirely limited by the condition of its acting through an organic tissue, is a question yet undetermined. Heat we know is favorable to the oxydation of carbon (combustion, fermentation, putrefaction, &c.,) under all circumstances. Has light an opposite property also under all circumstances, or is this opposite property of light limited to the condition of its acting through the medium of an organism? I hope the experiments already commenced and still in progress, by my brother Prof. John LeConte, and published in the last proceedings and in the American Journal of Science and Arts, vol. 24, p. 317, will eventually furnish the means of solving this very important problem. I do not wish to anticipate the final results of these experiments, but it seems to me that the negative results thus far obtained, rather support the view that the action of light is not thus limited. In all experiments on this subject the light and heat of the sun have been combined. Now heat we know is favorable to combustion. The fact then that combined light and heat produced no effect, would seem to indicate that light counteracted the effect of the heat of the sun.

5th. *Etiolated plants*, or plants artificially blanched by exclusion of light, exhibit the same phenomena and for the same reason. These plants cannot receive their organizing force

ough the decomposition of CO_2 by sunlight: therefore they obliged to obtain it from decomposition of organic mat- . Hence these plants require organic food, hence also they ›lve CO_2 instead of oxygen. In this case also decomposition ›rganic matter, with a separation of a portion of the carbon in form of CO_2, furnishes the organizing force. In the absence any external organic matter in the form of humus or manure, ›lated plants like germinating seeds will feed for awhile upon ;anic matter previously accumulated in their tissues in the m of starch and actually *lose weight* of solid matter.*

3th. In a most interesting and suggestive article in the Biblio-que Universelle (Archive des Sciences,†) on the subject of mus, M. Risler shows in the most conclusive manner that ;anic matter in a soluble condition (soluble humus) is taken by *almost all plants*. This fact had been previously proved ›erimentally by Th. de Saussure, but having been denied by big, it has been very generally neglected by vegetable physi-gists. The doctrine of Liebig and of physiologists generally, hat, except in case of pale plants, organic matter is decom-ıed into CO_2, HO and NH_3, i. e., must fall into the mineral ıgdom before it can be absorbed and assimilated by plants, l therefore that organic manures only supply the same sub-nces, and in exactly the same form, which are already sup-ed, but in insufficient quantities, by the atmosphere. But M. ler repeats with great care the experiments of de Saussure, l confirms the accuracy of his conclusions. Hyacinths and ıer bulbs were placed with their roots suspended in water col-d with soluble extract of humus. When these plants were ced in the sun, the water became rapidly decolorized. Other ›ts such as carrots, also germinating grains of wheat, were ob-ved to produce the same effects. An extract of humus was ›osed at a somewhat elevated temperature to sunlight under a l glass. Microscopic plants developed in great abundance. long as these plants continued to develop the infusion was nsparent and did not putrefy in the slightest degree: and yet re was a constant evolution of CO_2 as shown by analysis of air in the bell-glass. "Now the cellules formed in the liquid ıtained carbon. This carbon did not come from the CO_2 of air, for the liquid, far from *absorbing*, disengaged CO_2. There-e the soluble humus must have furnished the carbon *directly* the vegetable cells." It could not have furnished it *indirectly* the form of CO_2 derived from decomposition of the organic .tter, otherwise *oxygen* instead of CO_2 would have been elimi-ed. M. Risler thinks moreover that the *embryo* in germina-n takes up soluble organic matter in the form of humus in

* Carpenter, Comp. Phys., p. 285.

† Bib. Un. Arch. des Sci., new period, vol. 1, p. 305.

addition to the soluble organic matter contained within the cotyledons, and that the evolution of CO_2 by germinating seeds is due in part also to the oxydation of humus. Finally, according to the same author, the formation of roots in all plants, but particularly those containing much starch or sugar, is due to the direct absorption of humus, and not, as is generally supposed, by the fixation of carbon by means of light. "In order" says he "that CO_2 of the air should form these substances, it is necessary, in the beet and the potatoe, that there should be a descending sap, which there is not." Moreover if the carbon was taken from the soil in the form of CO_2 there should be elimination of oxygen instead of evolution of CO_2; but the converse is the fact as has been proved in the most indisputable manner by de Saussure and Boussingault.*

Mülder is equally explicit in affirming that plants absorb soluble organic matter which is converted in the roots, by elimination of a portion of the carbon, into starch and sugar.—Mülder, pp. 620, 664, 682. Thus according to these authors, *sap is actually elaborated by the roots* from organic manures.

Now according to the theory which I propose, *this change from humus into starch, sugar or cellulose, furnishes an additional life-force.* Humus is a more highly carbonized substance than either starch or cellulose. By the *partial decomposition of humus* in the tissues of the plant, with the elimination of a portion of its carbon (removed by oxydation) *a chemical force is set free which serves to assimilate the remainder.* Hence, this process of evolution of CO_2 as we have already said, is opposed by light but favored by darkness and heat. Light favors the formation of chlorophyll, of woody fibre, of essential oils, gums, &c.; darkness, heat and organic manures, favor the formation of sugar, starch, &c. Hence the explanation of the well known fact that by covering up the lower portions of potatoe plants by heaping earth around them, many buds which would otherwise form leafy *branches* develop into *tubers.* Hence also the explanation of the equally well known fact that the roots of plants seek and grow most rapidly in the direction of most abundant food. If the sap is elaborated entirely in the leaves, it is difficult to understand why the descending sap should flow in greater abundance in one direction than another. But if sap is elaborated in *the root itself* it is easy to see why growth is most rapid in the direction of most abundant manure. It is easy to see, too, why roots avoid the light; since light decomposes CO_2 and therefore must be unfavorable to the formation of this substance.

7th. It is a well known fact that the so-called *respiration of plants* consists of two distinct and apparently opposite processes, 1st, the absorption of CO_2 by the leaves and also in solution by

* Bib. Un. Arch. des Sciences, new series, vol. 1, p. 5.

the roots, the decomposition of this CO_2 by means of light with the fixation of the carbon and the elimination of the oxygen: 2nd, the recomposition and evolution of Co_2. The *decomposition* of CO_2 undoubtedly takes place in the leaves, but where the recomposition of CO_2 takes place is not so well ascertained. It is exhaled however, like the oxygen, from the leaves. The process of decomposition of CO_2 takes place only during the day as light is absolutely necessary for this process. The *recomposition* of CO_2 takes place night and day, although its exhalation according to some observers seems to be more abundant during the night. The process of decomposition of CO_2 is well understood—of that of recomposition our knowledge is very imperfect. M. Risler's explanation of this latter process seems most probable. Plants, we have seen, undoubtedly absorb soluble organic matter, i. e., humus. Humus we know is a more highly carbonized substance than cellulose or starch. This humus is therefore oxydized in the roots and interior of the trunk, away from light, by means of oxygen also absorbed by the roots and thus forms CO_2. This CO_2 then circulates in the sap to be exhaled by the leaves or perhaps to be again decomposed by sunlight in this organ. In the absence of light the whole is exhaled undecomposed. This readily accounts for the apparently greater exhalation of CO_2 during the night. A series of well conducted experiments would test the truth of this view. If it is true, there should be a relation between the richness of the soil in organic manures and the amount of CO_2 exhaled. For a given amount of growth, the amount of CO_2 exhaled is the measure of the amount of food taken up in the form of organic matter, and the amount of oxygen exhaled is the measure of the amount of food taken in the form of mineral matter. Or if the exhaled CO_2 is decomposed in the leaves during the day, then of course the difference between the amount exhaled during the night and day would enter as an element in the calculation. Also it would seem that those plants, especially, which frequent rich shady spots, should exhale proportionally more CO_2 and less oxygen, than those loving thin soils and sunny places.

In plants then, there are *two sources of organizing force*, the relative proportion of which varies infinitely, according to the amount of light, heat, color of the plant and richness of the soil in organic matters. The two sources are *immediately*, 1st, the decomposition of CO_2, 2nd, the decomposition of soluble highly carbonized organic matter: *remotely* the two sources are *light* and *heat*. In plants which first take possession of desert spots, bare rocks, &c., the *first* is the only source. In pale plants and fungi the *second* is the only source; but in most plants the two are combined in various proportions. The 1st must of course be considered the most fundamental and necessary, the 2nd being

evidently supplementary. The decomposition of CO_2 by sunlight may be considered as the original source of all vegetation, but in most of the higher orders of plants the process of nutrition is expedited by the reabsorption of organic matter before it again returns to the condition of CO_2, HO and NH_3.

8th. The *egg* during incubation, absorbs oxygen, evolves CO_2, and probably HO, and loses weight. As the result of this evolution of CO_2 we find the egg *develops*. What it *loses in weight* it *gains in organization*. Now what is the source of the organizing force? It evidently bears a direct relation to the loss of weight. Here also, then, we have *partial decomposition furnishing the necessary force*. A portion of the organic matter, falling from the organic to the mineral plane, sets free a force which raises the remaining portion into a slightly higher condition. Heat is evidently the physical force or agent which is transformed, not directly but *indirectly*, *through chemical affinity*, into vital force. In other words, heat is the agent which effects the necessary decomposition. The phenomena of development of the egg is, therefore, very similar to that of the seed.

9th. *After the hatching* of the egg, the animal no longer loses weight; because recomposition of food taken *ab externo* proceeds *pari passu* with decomposition. But in this case also *decomposition supplies the force by which recomposition is effected*, and growth and development carried on. As this is an important point I will attempt to explain it more fully.

It is well known that in the animal body there are, going on constantly, two distinct and apparently opposite processes, viz., decomposition and recomposition of the tissues; and that the energy of the life is exactly in proportion to the rapidity of these processes. Now according to the ordinary view, the animal body must be looked upon as the scene of continual strife between antagonistic forces chemical and vital; the former constantly tearing down and destroying, the latter as constantly building up and repairing the breach. In this unnatural warfare the chemical forces are constantly victorious, so that the vital forces are driven to the necessity of contenting themselves with the simple work of reparation. As cell after cell is destroyed by chemical forces, others are put in their place by vital forces, until finally the vital forces give up the unequal contest and death is the result. I do not know if this view is held by the best scientific minds at the present day, as a fact, but it certainly is generally regarded as the most convenient method of representing all the phenomena of animal life, and as such has passed into the best literature of the age. Certain it is however that the usual belief, even among the best physiologists, is that the animal tissue is in a state of unstable equilibrium; that constant decomposition is the result of this instability, and that this *decomposition and*

me, creates the necessity of recomposition—in other words the necessity of food. But according to the view which propose, decomposition is *necessary to develop the force* by organization of food or nutrition is effected, and by which ious purely animal functions of the body are carried on—composition not only creates the *necessity* but at the same rnishes the *force* of recomposition.

it will no doubt be objected that according to the princi- conservation of force, decomposition of a given amount er can only effect the recomposition of an equal amount— given quantity of matter falling a given height, can only n equal quantity an equal height: the whole force devel- y decomposition seems to be expended in maintaining the t a given position. How then can *growth* and *animal* go on? The answer to this question is obvious enough ve recollect the nature of the food of animals. Animals ll known cannot feed upon mineral matter but only on ready organized, at least up to the vegetable condition. ien decomposition takes place, the animal matter returns ger to the vegetable condition from which it was immedi- iised, but to the mineral condition. It is decomposed into O and *urea*. This last substance though not strictly a l substance is far below the condition of vegetable matter. ; is evident that *a given quantity of matter falling down e condition of animal to that of mineral matter*, i. e., from to the 2nd plane, *would develop force sufficient to lift a quantity of matter from the vegetable to the animal condi-* e., from the 3rd to the 4th plane, and yet perhaps leave residual force unexpended. Thus it is possible, and not ssible but certain, on the principle of conservation of hat decomposition of animal tissues should set free, a part of which is consumed in the recomposition of a amount of new matter and thus maintaining growth; a animal heat and a part in animal activity of all sorts. view of the case we see at once the absolute necessity e food of animals should be organized. Upon the princi- conservation of force, growth and animal activity, in a nimal life, would otherwise be impossible.

llows also from the above, that the higher the organization food the smaller the amount of force necessary to effect ation, and therefore the larger the amount of residual be expended in animal heat and animal activity. In find a ready explanation of the superior activity of *car- s* animals, and the loss of animal activity which results te of domestication from the use of vegetable diet; also supposed superior activity of men fed upon meat diet.

10th. I have spoken thus far of only one source of vital force in animals, viz., the *decomposition of the tissues.* I have attempted to show how, upon the principle of conservation of force, this is sufficient to carry on the growth and the activity of the animal organism. But decomposition of the tissues, though the fundamental source—the source characteristic of and peculiar to animals—of immediate and universal necessity in this kingdom, and in many cases sufficient of itself, is not the only source. There is also in animals as in plants a supplemental source, viz., *the decomposition of food.*

It is well known that the food of animals consists of two kinds, the nitrogenous, such as albumen, fibrin, casein, &c., and the non-nitrogenous, such as fat, starch, sugar, gum, &c. According to all physiologists since Liebig, the nitrogenous alone are used in the repair and growth of the tissues. The non-nitrogenous are either quickly consumed in respiration, or else are laid up in the form of fat for future consumption in the same way. Now there can be no doubt that animals may live entirely on nitrogenous food; in which case the whole vital force, whether for assimilation of food or for animal heat and animal activity, is derived from the decomposition of the tissues. This is the case also, apparently, in the starving animal, particularly if lean. But in almost all cases much food in the form of fat, starch, sugar, &c. (non-nitrogenous), is never transformed at all into tissues, but is taken into the blood, gradually decomposed, oxydized in the course of the circulation, changed into CO_2 and HO, and finally removed by exhalation from the lungs. Now what is the object of the non-nitrogenous food, since these do not form any part of the tissues but are again decomposed and thrown out of the system? The answer usually given is that such food is used in the animal economy solely as fuel to keep up the animal heat. On this view it is difficult to see why this class of food should be used at all, especially in warm climates. But according to the view which I propose we have here an *additional source of vital force.* The decomposition of these ternary compounds sets free a force which is used in organizing and assimilating other matter (nitrogenous) and in producing animal activity and animal heat. As in plants, although the decomposition of CO_2 by sunlight is all that is absolutely necessary for growth and development, yet the decomposition of organic food supplies an additional force which greatly increases the vigor and rapidity of vegetation; so in animals, although *decomposition of the tissues* is all that is absolutely necessary to furnish the force of growth and the phenomena of animal life generally, yet the decomposition of non-nitrogenous organic *food* furnishes additional force by which growth and animal activity may be maintained without too great expenditure of the tissues.

11th. In what then consists the essential difference between animals and plants? There can be no doubt that it consists, generally, in their relations to one another and to the mineral kingdom. Plants occupy a middle ground between the mineral and animal kingdom—a necessary halting place for matter in its upward struggles. But when we attempt to define this relation more accurately, the problem becomes much more difficult. It is indeed probable that no single distinction will be found free from objection. The commonly received and, to a certain extent, very correct idea is, that the essential distinction consists in their relation to CO_2. Plants *de*compose and animals *re*compose CO_2. The beautiful manner in which the two kingdoms stand related to each other through these converse processes, is familiar to all. But it is well known that most plants carry on both of these processes at the same time, while some, as fungi, pale plants, &c., only recompose CO_2 like animals. It seems to me that at least an equally good fundamental distinction may be found in this, that in plants the fundamental and necessary source of vital force is the decomposition of its *mineral food;* while in animals the fundamental source of vital force is the decomposition of its *tissues.* It is true that in what I have called the supplementary source of vital force they seem to meet on common ground, viz., the decomposition of *organic food;* but even here there is this essential difference, that in plants this decomposition of organic food is only partial, and therefore furnishes not only *force* but *material* for organization; while in animals the decomposition is complete and therefore furnishes only *force.*

As a necessary result of the above, it would seem that the "*vortex*" of Cuvier is characteristic of animals. There seems no reason to believe that a tissue once formed in plants is ever decomposed and regenerated, as is the case in animals. When plant-cells decompose, the tissue dies. Hence the absolute necessity of *continuous growth* in plants. In this kingdom *life* is synonymous with growth. There is no possibility of life without growth. There is no such thing as determinate size, shape, or duration. There is no such thing as maturity, or if so, death takes place at the same instant. As cell life is necessarily of short duration, and as there is no regeneration of tissues in plants, it is evident that the life of the tissues must be equally short. Thus plant life can only be maintained by the continual formation of *new tissue* and a constant travelling of the vital force from the old to the new. In exogenous plants the direction of travel is from the interior to the exterior; in endogens from exterior to interior, and still more from below upwards by the continual addition of new matter at the apex. In fungi where there is no such superposition of new tissue upon the old, where

growth takes place by multiplication of cells throughout the whole plant—in other words, a true interstitial growth as in animals—since there is no regeneration of tissues, the duration of the life of the plant is limited by the duration of cell-life.

The *respiration* of animals, also, differs essentially from that of plants. At one time the absorption of CO_2 and exhalation of O was called the respiration of plants. It is universally admitted now, however, that this is rather a process of assimilation than of respiration. The recomposition and exhalation of CO_2, as soon as discovered, was very naturally likened to animal respiration, and is in fact looked upon by many, as for example the physiologist Carpenter, as a true respiration. But there is an essential difference between this and animal respiration, which I have already pointed out. Its very significance is radically different. The essential object of animal respiration is the removal of poisonous decomposed matters from the organism. The so-called respiration of plants, on the contrary, is rather a process of assimilation, since by it the too highly carbonized organic food, by the elimination of a portion of its carbon, is brought into a proper condition for organization. A true respiration is necessarily connected with a change of the matter of the tissues—with the vortex of Cuvier—which has never been shown to exist in plants. It is true the exhalation of CO_2 has been looked upon by some physiologists as indicative of a regeneration of tissues, but I have already shown that this is probably not the case, but on the contrary that the CO_2 is formed by the partial decomposition of highly carbonized organic *food*.

12th. The most natural condition of matter is evidently that of chemical compounds, i. e., the mineral kingdom. Matter separated from *force* would exist, of course, only as elementary matter or on the *first plane;* but united with force, it is thereby raised into the *second plane* and continues to exist most naturally there. The *third plane* is supplied from the second, and the fourth from the third. Thus it is evident that the quantity of matter is greatest on the second and least on the fourth plane. Thus nature may be likened to a pyramid, of which the mineral kingdom forms the base and the animal kingdom the apex. The absolute necessity of this arrangement on the principle of the conservation of force may be thus expressed. *Matter*, *force* and *energy* are related to one another in physical and organic science somewhat in the same manner as *matter*, *velocity* and *momentum* in mechanics. The whole *energy* remaining constant, the greater the *intensity* of the force (the elevation in the scale of existence) the less the quantity of matter. Thus necessarily results what I have called the pyramid of nature, upon which organic forces work *upwards* and physical and chemical forces *downwards*.

13th. As the matter of organisms is not created by them, but is only so much matter withdrawn, borrowed as it were, from the common fund of matter, to be restored at death; so also organic forces cannot be *created* by organisms, but must be regarded as so much force abstracted from the common fund of *force*, to be again restored, the whole of it, at death.* If then vital force is only transformed physical force, is it not possible, it will be asked, that physical forces may generate organisms *de novo?* Do not the views presented above support the doctrines of "equivocal generation" and of the original creation of species by physical forces? I answer that the question of the origination of species is left exactly where it was found and where it must always remain, viz., utterly beyond the limits of human science. But although we can never hope by the light of science to know *how* organisms originated, still all that we do know of the laws of the organic and inorganic world seem to negative the idea that physical or chemical forces acting upon inorganic matter can produce them. Vital force is transformed physical force, true, but the necessary *medium* of this transformation is an organized fabric; the necessary condition of the existence of vital force is therefore the previous existence of an organism. As the existence of physical forces cannot even be conceived without the previous existence of matter as its necessary *substratum*, so the existence of vital force is inconceivable without the previous existence of an organized structure as its necessary substratum. In the words of Dr. Carpenter, "It is the speciality of the material substratum thus furnishing the medium or instrument of the metamorphosis which establishes and must ever maintain a well marked boundary line between physical and vital forces. Starting with the abstract notion of force as emanating at once from the Divine will; we might say that this force operating through inorganic matter, manifests itself as electricity, magnetism, light, heat, chemical affinity and mechanical motion; but that when directed through organized structures, it effects the operations of growth, development and chemico-vital transformations."

* Carpenter, Phil. Trans., 1850, p. 755.

ART. XXXV.—*Report on the Exploration of two Passes, (the Kootanie and Boundary Passes) of the Rocky Mountains in* 1858; by Captain BLAKISTON, Royal Artillery. (With a map.)*

[WE have been favored by General Sabine through Dr. A. D. Bache with an early copy of Captain Blakiston's Report, which with its accompanying map we take pleasure in bringing before our readers. Capt. B. was detached from his position as Magnetician to the expedition of Capt. J. Palliser for exploring British N. America, for the purpose of taking command of the party whose adventures and discoveries he records. The Victoria Gold Metal of the Royal Geographical Society has just been awarded to Captain Palliser for the successful results of his exploration of large tracts in British North America, and more particularly for the determination of the existence of these practical passes across the Rocky Mountains within the British Territories.

The interest of Capt. Blakiston's Report will not be diminished by the appendix we add to it from Sir R. I. Murchison's anniversary address, detailing some of the results of the Palliser Expedition.—EDS.]

On the 12th of August, 1858, I left the camp of the main body of the Exploring Expedition at the site of Bow Fort, base of the Rocky Mountains, lat. 51° 9′ N., long. 115° 20′ W., and after crossing the Bow River by a ford about four miles above that point, I gained ground to the eastward, so as to get clear of the broken and wooded country on the edge of the mountains.

My party consisted of three Red River half-breed voyageurs, Thomas Sinclair, Amable Hogg, and Charles Racette, besides a

* To H. MERIVALE, Esq., *Under Secretary of State for the Colonies.*

13, Ashley Place, April 18, 1859.

SIR,—I have the honor to enclose a Report which I have received by post from Captain Blakiston of the Royal Artillery, with a request that it should be transmitted for the information of H. M. Government.

The Report, with Map and Sections, states the particulars of Captain Blakiston's Explorations of the Kootanie and Boundary Passes of the Rocky Mountains; the first known only by name, and the second unknown, except to the native Indians; the Kootanie Pass proving to be the most southern, and by far the shortest yet known in the British territory.

I have at the same time received from Captain Blakiston a continuation of the magnetic observations which constituted his special duty, up to the date of the transmission of his letter. These evince the same care and skill which have characterized his former observations. The results will be laid before the Royal Society, as those of his earlier observations have been.

In the successful conduct of the exploration confided to him by Mr. Palliser, Captain Blakiston has had an opportunity of manifesting his desire and capability of contributing towards the accomplishment of the Geographical objects of the expedition, which will, I trust, obtain for him the approval of H. M. Government.

(Signed) EDWARD SABINE, Major-General, R. A.

Thickwood Cree Indian "James," whom I had engaged as hunter to the party. I had ten horses, five of which were used for riding, and the rest carried the packs, containing a quantity of ball and powder, tobacco, a few knives, and other articles of small value for Indian trade; also some dried meat and pemmican, with tea, sugar and salt, as well as two boxes containing my instruments, books, &c.

Soon after leaving Bow River, we crossed one of its tributaries, the Kananaskasis or Lake River, a rapid stream coming out of the mountains from the southwest; here we saw the remains of many wooden carts, which had been abandoned by a party of emigrants from Red River Settlement, under the late Mr. James Sinclair, on their way to the Columbia, in 1854, who had found it impossible to drag them further into the mountains. This pass, I believe, follows the course of the river to its source, and is the one by which Sir George Simpson governor of the territories of the Hudson's Bay Company, as well as another party of emigrants crossed the Rocky Mountains in 1841. In the past season it was travelled by Capt. Palliser.

The forest consists of spruce (*Abies alba*), a small pine (*P. Banksiana*), and another rough-looking *Abies* which grows to a large size, also a few balsam poplar, and aspen. In travelling through these mountain forests, the greatest obstruction is the fallen timber, which lying about in all directions, causes much exertion to the horses, and confines them to a slow pace. During this first day's travel I noticed the devastating effects of a tempest; numbers of trees had been blown down, and many broken short off. The work of destruction had evidently been of this year, but there were also signs of former work of the same character.

The following day, our course still tending a good deal to the eastward, carried us farther and farther from the mountains, but we passed within twelve miles of a marked outlier, which from its peculiar form, I called "The Family." After this as we travelled along through a partially wooded country, and receding from the near hills which obstructed the view, a sharp peak entirely covered with snow, opened to us at about forty miles distance. The wind was from the westward, and to the east of the summit of the peak rested a mass of white cloud, which was very marked, for there were no other clouds to be seen, with the exception of a few light cirri over head. This attending cloud gave the mountain the appearance of an active volcano, and the effect against the clear sky was extremely beautiful. The phenomenon was caused by the aqueous vapor of the warm Pacific breeze, being condensed by the coldness of the snow, and appearing as a cloud to the leeward of the peak. I took careful

bearings of this mountain, to which I gave the name of "The Pyramid."

We camped at the forks of a creek, called by our hunter the "Strong Current." Here he was successful enough to procure a few fine mountain trout, which proved a very agreeable change to our ordinary fare, which consisted of dried buffalo meat, containing by no means too large a proportion of fat, washed down by tea. Bread was not in our bill of fare, and I may here state, that during the whole summer while travelling, with the exception of two Sundays, I never tasted a morsel of farinaceous food. This may appear astonishing, but when continually travelling, with the appetite sharpened by a ride over the prairie in the cool breeze of the mountains, one becomes acccustomed to do without flour, salt, sugar, &c., which under other circumstances would be considered indispensable.

The next day was Saturday; we rose early, packed the horses, and made a start as usual about sunrise, and travelled on through much the same sort of country, the up-lands being generally wooded, while the bottoms were partially covered by scrub-willow and other bushes. We halted between 8 and 9 A. M. for breakfast, giving the horses a "spell" of a couple of hours or so; then started again, and gained a somewhat elevated position, from which we had an extensive view of a fine valley, watered by two clear mountain streams, which as they neared the edge of the great plains, stretching probably without break for 700 miles eastward, united, and with mingled waters, pursued their course towards Bow River, ultimately to pour themselves into the icy basin of Hudson's Bay. We continued on until we reached the southernmost of the two creeks, within ten yards of which, under the shade of some fine poplars, I pitched my small patrol tent. The valley bottom was a fine piece of prairie pasture for the horses, and presented a most suitable resting-place for a Sunday camp. I had (for it was only two o'clock), halted in sufficient time to allow me to obtain an observation of the sun during the afternoon for comparison with one I hoped to obtain on the morrow, and so rate my chronometer. This important instrument was carried each day, turn about, by one of the men, who for that day did nothing else but carry it as carefully as possible. I would recommend this plan to future explorers. In a large party, a few of the steadier hands should be selected for this service; but the same man should never be obliged to carry the instrument every day, lest he become careless.

My ordinary mode of travelling, gave the horses six to seven hours' work per day, with the exception of Sundays. Frequently I halted from breakfast till noon, in order to obtain an observation for latitude, in which case I camped later. I never, however, gave up the plan which I adopted from the first, of making

n early start, and getting the best part of the day's work over efore noon. There are many reasons in favor of it. The orses were mostly Indian ponies, which are hardy and work 'ell on grass. They grow somewhat lean while living out uring the severe winter weather, but fatten rapidly with the ppearance of the new grass in the spring. They are not accus- omed to shoes, but I had some on three of them, whose feet I onsidered too much worn down for the rocky ground of the ountains. On camping, the horses after being watered, are left themselves for the night, the fore legs of those likely to wan- er being hobbled with a piece of soft leather. They are very gacious in following a trail. The 15th of August was a unday. While continually travelling, it will be found that st one day in seven is required by man and horse, the former king advantage of it to wash and mend clothes.

The weather continued fine, and this day the thermometer se to 85° in the shade, with a clear sky, and fresh breeze off e mountains in the afternoon, the day closing with a calm ening. This mountain breeze appears to be a regular occur- nce during the fine summer weather of this season. On each three successive days of fine weather which we enjoyed at e site of Bow Fort, the morning was calm, at about 7½ A. M., e wind commenced lightly from about W.S.W. off the moun- ins, and gradually increasing in the middle of the day and ternoon it blew a fresh breeze from the same point, with usu- ly some *cumuli* over the mountains, which disappeared before aching the plains; in the evening the wind fell, and the night as calm. The explanation of this phenomenon is the same as at of the sea breeze so unvarying in tropical islands, namely, at as the sun gains altitude, the great plains which are entirely airie become heated, and consequently, the air in contact with em ascends and is replaced by the cooler air from the moun- ins.

Our general course for the next three days was a point east of uth, for we were now as far out from the mountains as our dian thought requisite. We were, however, within the out- ing ridges, which are numerous, and all run parallel to the rger ranges of the great chain, namely, S.S.E. Thus travelling e course we were on, we had very seldom to surmount any gh land, but passed along the valleys between these ridges.

The country was less wooded than that previously passed, ing for a considerable part, fine prairie slopes. The main nge or watershed, as I supposed it to be, was occasionally visi- e, through gaps in the nearer mountains, at a distance of about irty miles.

On the 16th our hunter was lucky enough to procure us some sh meat in the shape of a wupite or wa-waskasew (red deer)

of the Crees. In order to lighten the burthen of the horses and preserve the meat, the bones were taken out, and it was cut into thin flakes and half-dried over the night camp fire.

The same afternoon, as we arrived at Trap Creek, just above its junction with High Woods River, we found six tents of Thickwood Stone Indians who were just preparing their encampment. We camped along with them, and as usual, when with or near any Indians, my flag, a St. George's Jack, was hoisted on a pole in front of the tent. I gave them a present of some tobacco and fresh meat. These Stone Indians, with whom are associated also a few Crees, and whose hunting ground is the wooded and semi-wooded country along the base of the mountains, like the head-natives of the Saskatchawan, are a harmless and well disposed people towards the whites. Education has, thanks to the former Wesleyan missionary, the Rev. Mr. Rendall, and his successor the Rev. Thomas Wolsey, made some little progress amongst them; a few being able to read and write the Cree syllabic characters, now in general use among the missions of the northwest.

During the afternoon I held a talk with these Indians. I told them plainly for what reason we had been sent to the country; that Her Majesty was always glad to hear of their welfare, and that any message which they might have for her, I would take down in writing.

"We are glad," said an old man, "that the great woman chief of the whites takes compassion upon us, we think she is ignorant of the way in which the traders treat us; they give us very little goods and ammunition for our furs and skins, and if this continues our children cannot live. We are poor, but we work well for the whites. The Indians of the plains treat us badly and steal our horses, but we do nothing to them, for the minister tells us so." In answer to questions from myself, they said that they would wish white people to come and live among them, and teach them to farm, make clothes, &c., so that "their children might live," for the animals are getting every year more scarce. I may here state, that I have been fortunate enough this year to fall in with many camps of the different tribes of Indians inhabiting this country, from whom I always obtained as much information as possible on their present state, and their wishes as to the future; and I hope to draw up a report on the same for the information of H. M. Government; for without doubt, when deciding on the future of this country, some provision should be made for the poor uncivilized beings, to whom by right the soil belongs.

From these Indians I obtained a pair of saddle-bags of which I was in want, and by giving in barter a little ammunition and obacco, I changed a lame horse which I had brought with me or that purpose, for a good strong Indian pony.

Crossing Spetchee or High-woods River on leaving the Indians in the morning, we travelled over undulating prairie all the forenoon, crossing another tributary of this river. During the latter part of the day, we passed through a narrow wooded ravine between ruggod hills, covered with burned forest, and camped on a small creek. Here I determined to make a cache. Therefore selecting a good thick spruce tree, we enclosed in a box some ammunition, tobacco, and a few other things, which with half the bag of pemmican still remaining intact, rolled up in a piece of buffalo robe, we suspended from a branch about fifteen feet from the ground.

We were delayed some time next morning by some of the horses having strayed a distance into the woods during the night; however, when found they were quickly unhobbled, saddled, and packed, and we started not very long after our usual hour. The Indian trail led between numerous wooded ridges, but the greater part of the wood was burned. The soil of the valleys was usually a deep dark mould, supporting a luxuriant vegetation of the smaller plants. This is the nature of most of these mountain valleys. Where the strata are upheaved to the surface, the ground is of course rocky; such is, however, not often the case in the valleys, but the lines of strata running along the ridges are distinctly visible even when the grass is growing, owing to the difference of color of the grass on the almost bare rock. The strata run in the direction of the ridges, namely, a little east of south, and usually dip from, but in some few cases towards, the mountains, and at a considerable vertical angle.

In the afternoon we passed close on the left hand a very remarkable feature; it was a mass of rock projecting upwards from the top of a hill, and visible at a considerable distance; from its peculiar form I called it the "Chopping Block." Soon after, we gained the height of land between the waters of the Spetchee and Mocowans, or Belly River, and the wide prairie valley of the latter broke upon our view. We descended a short distance and camped at the first wood and water.

Before gaining Belly River in the morning, the quick and practised eye of the Indian caught sight of a herd of Buffalo in the valley, he therefore went ahead, and by the time we had halted on the river, and I had obtained an observation, he had killed one animal. I remained here until noon, in order to obtain a meridian altitude, and so complete my observation for latitude and longitude, occupying a portion of the time in measuring the heights of the successive river levels with the aneroid barometer.

These "river levels" are a very general feature in this portion of the Western Continent; I have observed them on all parts of

the Saskatchawan above the forks, and its tributaries issuing from the Rocky Mountains, as well as on the Kootanie fork of the Columbia on the west side, and the Flathead River in the mountains, from an altitude of 1000 to upwards of 4200 feet above the sea. They are in some places very marked, and appear as a succession of steps from the bed of the river to the level of the plain above, often in sight for miles, and running horizontally along either side. The tread of the step is of greater or lesser width, the rise nearly always abrupt and well marked. They were very decided in the valley of Bow River at the base of the mountains, where they appeared cut with mathematical accuracy.

The levels measured at Belly River were:—

	Above the sea.
Present bed of the river, - - - - -	4024
1st, river level, - - - - - - - -	4085
2nd, " - - - - - - - -	4176
3rd, the level of the valley, - - - -	4226

These river levels are for the most part, on the lower portions of the branches of the Saskatchawan, on a somewhat larger scale in vertical height, than near the sources.

I was now on Belly River at about the same altitude as on Bow River at the site of Bow Fort, namely, 4000 feet above the sea, although eighty-seven miles (geographical) in a direct line S.S.E. from it. From this point the route of the party may be traced on the plan attached to this report. The plan does not include the country to the northward, which has no connection with the passes reported upon. I have, however, the whole country mapped on a smaller scale.

The bed and sides of this river are rocky, the strata of hard gray sandstone, much inclined, and the current obstructed in places by immense granite boulders. We found no difficulty in crossing, the water though running swiftly, being not deeper than three feet, and about twenty-five yards across.

Looking through the gap in the near range through which the river issues, I saw a conspicuously dome-shaped mountain. It afterwards proved to be when seen from the plains, and also from the top of a mountain in the Kootanie pass, the highest and almost only peak rising above the others in this part of the mountains. After the distinguished British naturalist, I named it "Gould's Dome." The gap through which I had seen this mountain was in the eastern or near range, of very regular form, extending with the exception of this gap, for a distance of five and twenty miles without break. The crest of the range was of so regular a form, that no point could be selected as a peak, I therefore gave the whole the name of "Livingston's Range;" it is a very marked feature when seen from the forks of Belly River and the plain outside.

On leaving Belly River we rose considerably, and keeping along under Livingston's Range, the sun had dropped behind this great curtain before we camped. The spot was 540 feet above Belly River which we had left behind to the northward. Looking to the mountains ahead of us, I picked out the most prominent, and took bearings of them before the Indian who was in the rear hunting, came up. There were two near one another bearing thirty miles south, one of which, from the resemblance to a castle on its summit, I named "Castle Mountain;" to the east of these, but at a greater distance a portion of the mountains stretched out to the eastward. From reports which I had previously heard, I took the most easterly one standing by itself to be the "Chief's Mountain," which the Indian on coming up confirmed, and pointed out the place where on the morrow we should turn into the mountains.

This offset range occurs, as I afterwards discovered, just at the 49th parallel or International Boundary line.

The morning of the 20th of August was thick and hazy, with occasional showers of rain, which entirely prevented me from obtaining the good view of the country which I had hoped for, having seen but little in the uncertain light of the previous evening. I therefore travelled on, crossed Crow Nest River, and soon after noon gained the entrance of the Kootanie pass, where another of the branches of Belly River issues from the mountains. Here we struck a narrow but tolerably well beaten track, which the Indian informed us was the Kootanie trail, by which the Indians had crossed the mountains in the past spring. Making a turn therefore to the W.S.W., nearly at right angles to our former course, we followed this track which led up a narrow valley along the left bank of the river and between high wooded hills; the travelling was good, for we were on the even grassy river levels, and we camped at a spot where a small mountain stream entered the river from the north.

We were now fairly in the mountains, and had already overpassed the spot where our Indian guide knew anything of the road but by report; he knew that if all went right we should be some three or four days in crossing, and had been told that there was but one track, and that we were not likely to miss it. It may be asked why was I without a guide? The fact was, that a guide had been allotted to me by Capt. Palliser, but on leaving the camp of the expedition on Bow River, I had started without him on account of the sickness of his wife. He promised to start the following morning and overtake the party, which he failed to do. It will be seen subsequently, however, that I did not suffer by his absence, and I am now glad that he was not of the party, for I have no great faith in the so-called "guides," and think they are seldom worth their pay.

The entrance of this pass is in latitude 49° 34′ N., and longitude 114° 34′ W., being (consequently) forty English miles north of the Boundary line. I have omitted to insert the latitude and longitude of points where I obtained observations, because by referring to the map, the geographical position of any place may be seen.

We started at 5.40 in the morning with the sky overcast, and a drizzling rain, and soon entered thick woods and uneven ground, with a great many fallen trees, which caused the horses to travel slowly. We continued travelling in this way and gradually ascending along the course of a small creek running into Railway River, which we had left where the trail parted from it; this river was so named by me from the striking advantage offered by its "levels" for the entry of a railway into the mountains. Gradually the stream became less and less until after gaining considerable altitude it dwindled into a small quantity of water falling in a cascade. Here we passed Hero's Cliff, an enormous vertical escarpment, facing the east, of hard red sandstone or quartzite, with the strata dipping at least 45° to the west. We now rose rapidly as will be seen by reference to Section No. 1, (the Kootanie Pass); the trees became smaller, and we soon reached the region of rock and alpine plants; here were some large patches of snow and a couple of ponds of clear water; we passed over a quantity of debris of hard grey limestone of which the peaks on our right hand, namely, to the N.W., were composed. As we were now clear of all shelter, we felt the cold damp east wind, which blew a fresh breeze, and drove along scudding clouds which prevented any extensive view. We were now on the watershed of the mountains, the great axis of America; a few steps farther and I gave a loud shout as I caught the first glimpse, in a deep valley as it were at my feet, of a feeder of the Pacific Ocean. It was the Flathead River, a tributary of the Columbia. At the same moment the shots of my men's guns echoing among the rocks announced the passage of the first white man over the Kootanie Pass. I halted for the purpose of reading the barometer, which shewed an altitude of 5960 feet. It was just five hours since leaving our previous night's camp, at an altitude of 4100 feet.

This is no place for a dissertation on the physical geography of North America, but I may simply state, that in that portion of the Rocky Mountains, comprised between the parallels of 45° and 54° north latitude, rise the four great rivers of the continent, namely, the Mackenzie, running north to the Arctic Ocean, the Saskatchawan east to Hudson's Bay, the Columbia west to the Pacific, and the Missouri south to the Gulf of Mexico; thus we may say, that in a certain sense that portion of the mountains is the culminating point of North America, and I

›w, on the Kootanie Pass, stood as nearly as possible in the :ntre of it.

A rapid descent of two hours brought us to the Flathead iver, a clear and quick running stream, dividing a beautiful ırtially wooded valley enclosed by mountains; here we halted ›on after mid-day, having passed the great watershed, and de- ›ended again 1400 feet without breakfast.

During Sunday I did not move from my pleasant camp, here was wood, good water, and good pasturage, everything to › desired by the traveller. I was engaged in obtaining obser- ıtions for latitude and longitude, and computing them, writing p my notes, &c.: and I also made a sketch of the mountains ver which we had passed the previous day. The men brought : some ducks, grouse and trout, which made an agreeable ıange in our diet; two or three humming birds were seen ›out the camp.

The track now led up to the course of Flathead River, through ıick forests with occasional openings, crossing several mountain reams, feeders of the river. We halted for breakfast on an open ece of swampy ground. On moving forward again we plunged to thick forests, where the track was greatly obstructed by llen timber. The Kootanies cut through a good many of the llen sticks to allow of the passage of their horses, but still the 'eater number remain as they fall, and cause much twisting, ɹrning, and bránching of the track. We ascended gradually, ıssing a few fine pieces of open meadow, until we arrived near .e head waters of the river, when the different streams com- ›sing it became mere mountain torrents. Here we commenced steep ascent, the path ascending in a zig-zag up the hill; the ees, mostly spruce and fir, became smaller until we gained the ımmit of this knife-like ridge, from which an extensive view ' the mountains was obtained. I halted to contemplate the ene, take bearings, and read the barometer, which shewed an titude of 6100 feet. All appeared, however, utter confusion, ıch slight differences were there between the different moun- .ins and ridges. One peak alone shewed itself above the gen- 'al surface. It lay to the northward about thirty miles distant, ıd I recognized it as "Gould's Dome," which I had previously ımarked from the edge of the plains. I estimated it to be not .ore than 1000 feet above my present position which would .ve it an altitude of about 7000 feet. The rest of the moun- .ins appeared all about the same level, and but few of greater titude than the ridge from which I surveyed them; there were isible the main range or watershed, then a number of ridges ıd mountains densely wooded, and of somewhat less elevation; ter which, to the westward, higher mountains, the ranges gen- :ally taking a N.N.W. and S.S.E. direction. Such was the

scene to the north of my position, but to the southward the mountains appeared to have no general direction, as many running crosswise as lengthwise. I was now on a height of land between two branches of the Columbia; the rock was the same hard gray sandstone we had observed all along the base of the mountains on the east side, no granite showing itself anywhere.

Heavy dark clouds were gathering rapidly, and the louder and louder rumblings of thunder warned us of an approaching storm. We had descended but a few yards of the great western slope when the tempest broke with all its violence, and we were wet to the skin in a few moments; my own habiliments were far from waterproof, being simply a flannel shirt, a pair of leather trowsers, with a striped cotton shirt over all. The descent was very steep, the horses having in some places difficulty in keeping their legs, although the path was zig-zag; and the continual descending on foot was very trying to the legs. After some distance, however, the descent became less steep, and we continued our course for a couple of hours before coming to any place fit for camping. Although camping in the woods is always to be avoided with horses, we were at length induced to halt from the appearance of some old skeletons of Indian lodges, not knowing how far we might have to travel before coming to any open place; and we camped, for the first time, in a Columbian forest.

The change in the vegetation was first made evident to me on descending the mountain, by the appearance of a beautiful and regularly formed cedar, which for the sake of remembering the tree, I then called the "Columbian Cedar." It flourished at an altitude of about 5000 feet, and I subsequently observed it as low as 3000, but I feel doubtful as to whether it descends to the Tobacco Plains. Besides this I found, to me, a new *Abies* something like the Balsam Fir of the Atlantic slope, but with a rough bark, and growing to a large size; the Spruce and supposed Bank's Pine remained with a few Balsam Poplar and Birch, some of good size; also Maple and Alder as underwood. A new Larch appeared, an elegant tree; and around our camp were the dead stems of many deprived of life, no doubt in years past by fire, rising to an immense height, and tapering upwards perfectly straight, without a limb, to a fine point.

The next day we travelled on through these forests, continually descending, and before noon arrived at Wigwam River, where it passes between two high rocky hills, which, from their imposing appearance from this spot I called the North and South Bluffs. The bed of the river was deeply cut in the valley and exposed grand sand cliffs from two to three hundred feet in height, portions of these cliffs were broken, and pinnacles and blocks of different forms were left, having at a short distance a

st fantastic appearance. The track leaving the river and as- ιding a steep bank, carried us for five miles over a very rocky ce of country, where the trees were of stunted growth from nt of soil, to the junction of Wigwam River with the Koota- Fork of the Columbia. The former was forty yards wide l two to three feet deep, and the latter sixty yards across with epth of four to six feet, both running with a swift current, ir beds being rocky and stony. The Kootanie Fork could seen coming down a valley from the N.N.W., from near a ll marked mountain about twenty-seven miles distant, which been called "The Steeples," or Mount Sabine. I believe t not far above the Wigwam tributary another called the Elk 'er comes in from the north, down a long narrow valley in mountains. We descended about 300 feet, crossed the small er, and having lost the trail, camped for the night, the Indian's nion being that we must also cross the main river, which ıld have occupied more time than the decreasing daylight ıld allow us. On going lower down the river in search of a ter crossing place, I luckily struck on the proper trail leading the side of the river bank towards the south; so we turned hat night with the satisfaction that we were still to travel in morning on dry land.

'o the west of us, on the other side of the river, was a level, tially wooded country, a portion of the Tobacco Plains, which vill be seen by reference to the plan, is a tract of country of ut ten miles in width, stretching from near Mount Sabine on north, to the southward of the Boundary Line, bounded on west by low wooded hills, and skirting the feet of Galton's ıge on the east. The Kootanie Fork in its southern course, r the entry of Wigwam River, traverses these plains.

leing now at the western extremity of the Kootanie Pass, I pause to point out the capabilities it affords for a railway ss the mountains within the British possessions. I should nise that I have not sufficient evidence to be able to state the Kootanie Pass is absolutely the most advantageous place the crossing of a railroad from the Saskatchawan Plains to Pacific, because the mountains to the north have not yet ı sufficiently explored; but I am able to say that it is the t southern line within the British territory, and, as yet, by the shortest; moreover, I have every reason to believe, that most suitable portion of the mountains for the passage of a oad will be found to the south of Bow River.

he Kootanie Pass crosses the Rocky Mountains from the at Saskatchawan Plains on the east, to the Tobacco Plains he west, its extremity on the former side being forty, and on latter, eighteen English miles, to the northward of the Inter- onal Boundary, the 49th parallel of north latitude. Its

length is 40 geographical, or nearly 47 English miles, extending from longitude 114° 34′ to 115° 24′ W. It leaves the Saskatchawan Plains where they have an altitude of about 4000 feet above the sea, rises 2000 feet to the watershed of the mountains, descends to Flathead River, again to an altitude of 4000, follows up this river to its head waters, then crosses a precipitous ridge, reaching an altitude of 6000 feet; it then descends the great western slope, falling 2000 feet in two miles of horizontal distance, after which, by a nearly uniform grade of 100 feet per geographical mile, it gains the Tobacco Plains at the point where the Wigwam branch enters Kootanie River.

By reference to section No. 1, it will be seen that there are three obstacles to the passage of a railroad; namely, two mountains and one steep slope. As to the mountains, they could, I consider, without difficulty be pierced by tunnels; the great western slope is a more serious obstacle; however, in the following details I hope to show that it also may be overcome.

From the forks of Belly River on the east side, the line would traverse the gradually ascending prairie to the entrance of the pass where Railway River issues from the mountains. This river would be followed up with a grade of 1 in 180, or 34 feet per geographical mile for 7½ miles, the "river levels" affording considerable advantages; leaving this river it would follow the course of my track marked on the map. A cutting of about 3½ miles would lead to a tunnel of nearly five miles in length, which would pierce the Watershed mountain, and come out in the valley of Flathead River, the whole having a grade of 1 in 130, or 47 feet per geographical mile. On emerging into the valley, the line would skirt the base of the mountains to the north of the track, thereby avoiding a steep descent, then following up the river with a grade of 40 feet per geographical mile it would reach the rise of the western ridge, at a height of 5,100 feet above the sea. This would be the culminating point of the line, from which in a distance of ten geographical miles, it has to fall 1,900 feet to the North and South Bluff, and after that, by a slope of 54 feet per geographical mile for five miles to reach the Tobacco Plains, crossing the Kootanie Fork by a bridge. This I propose to accomplish in the following manner. From the culminating point, to pierce the ridge by a tunnel of three geographical miles, and continue the line along the side of the hills to the north of the track, until reaching the North Bluff, the whole with a grade of 190 feet per geographical mile. This portion of the line of ten geographical miles, would have to be worked by a wire rope, and one or more stationary engines. Regarding the remaining five miles to the west of the North and South Bluffs, a careful survey is required to determine whether a grade not too steep for locomotives can be made. My meas-

urements, taken with so uncertain an instrument as an aneroid barometer, must not be depended on to a few feet; they give a fall of 54 feet per geographical mile, or 1 in 112.

As regards the country to the west of Kootanie Fork, I can say nothing, but that no mountains were visible to the distance I could see; neither have I any personal knowledge of the Saskatchawan Plains to the eastward of the forks of Belly River. But it is probable that these great prairies stretch without break from this point to the Red River settlement, and that in the construction of a railroad, little more labor would be required than that of laying down the rails. The following statement of distances to be traversed by a railroad to the Pacific within the British territories may be of interest:—

	Geog. miles.
Lake Superior to Red River settlement, - - -	320
Red River settlement, *viâ* elbow of south branch of Saskatchawan to Rocky Mountains, - -	700
Kootanie Pass, - - - - - - - -	40
West end of Kootanie Pass to mouth of Frazer's River, Gulf of Georgia, - - - -	300
Total, Lake Superior to Pacific, - -	1360

Probable length of railroad, 2300 English miles.

Thus it will be seen that out of the whole distance one-half is over level prairies, and but 40 miles through mountains.

To resume the narrative of my journey: On the morning of the 25th of August, at starting we were obliged to climb the face of a steep hill-side for the purpose of keeping on the left bank of the Kootanie Fork, which here sweeps in close under an outer range of the mountains, having a north and south direction, and which I have called "Galton's Range." We gained a considerable altitude above the river, which ran at our feet, and of whose course I had a view for some distance. The banks were vertical and rocky, and the stream appeared to continue swift. Both horses and men had enough to do in climbing up, and then coming down again from the heights. I was well repaid for my climb by the remainder of the day's travel, which was through magnificent open forests with patches of prairie, sometimes of considerable extent. These forests were the finest it had been my good fortune to see. A splendid species of pine and the larch previously spoken of, with their bright red barks, rose from the ground at ample distances; no brushwood encumbered their feet or offered impediment to the progress of wagons, which might move in every direction.

As we advanced along the prairie the trail forked, and our Indian took the branch which led nearest the river, as from information he had received, he believed it to be that which led to the trading post. Towards evening, according to my reckon-

ing, we crossed the Boundary Line, and camped about two miles within the American territory, and not more than a mile from the river. In a few minutes, a Kootanie Indian came to us on horseback. My Indian guide "James," knowing but a few words of his language, and a little Blackfoot, and he not knowing one word of Cree, we had some difficulty in comprehending that he wished to inform us that there were no people at the trading post, which he described as being quite close. A small present of tobacco and something to eat were thankfully received by him, and he took his leave. Shortly after there came several more from the same camp, having a chief among them. They were mounted on good looking horses, and raced up to our camp as hard as they could gallop, no doubt with the idea of creating an impression. The evening was spent in a talk with them, one of them understanding Blackfoot. It was dark before they took their departure, having promised that they would meet us in the morning at the trading post, to guide us to their camp, where they wished us much to come, saying they had some provisions.

Following the track still S.S.W. the following morning in a thick fog, we came on the river, and within a few hundred yards found three diminutive log houses. Two of them, not over ten feet square, had evidently been used for dwellings, and to enter them it was necessary to crawl through a hole as an apology for a door; the other, somewhat larger, without a chimney, we were informed was the Kootanie chapel which had been erected the previous spring when a priest was there.

The Kootanies afterwards informed me that white people always come in the fall, remaining for the winter trading with them, and returning to Colville, eight or ten days' journey, in the spring. These are the Hudson's Bay Company's people, and this post is the same that figures on maps in large letters as "Fort Kootanie." I remained here till noon, and obtained observations, which placed the post in latitude 48° 55'·5 N., and longitude 115° 31' W., thus a little over five English miles south of the Boundary.

In the afternoon I rode four miles across prairie in an easterly direction with a chief, the pack animals following, and arrived at the Kootanie Camp, where I was under the necessity of shaking hands with every man, woman and child. The people had a rather dirty and wretched appearance, but their herds of horses, and some few horned cattle, showed that they were not poor.

Having pitched my tent at a short distance from the lodges of the Indians, which were in a pleasant situation near a small stream with some woods along it at the base of Galton's Range, I was soon inundated with presents of berries dried and fresh, dried and pounded meat, and cow's milk. Of course, although no payment was asked, I paid these people for their food in tobacco, ammunition, &c.

Seeing that there was no chance of starving, I determined on remaining here some days for the sake of the horses; the next five days were therefore spent in trading, and exchanging horses, buying provisions, &c., and obtaining by actual observation and Indian report, such knowledge of the country as I was enabled to do.

The weather was fine, and generally calm, but rather warm, the thermometer ranging from 47° to 82° in the shade. I should have said, that in my passage over the mountains, I had experienced no cold nights, the temperature at sunrise being usually about 50°, once only so low as 37°.

I made an excursion to the north of the boundary with my sextant, to obtain as near as possible the precise position of the line; I found no remarkable feature to mark it, but noted the place where it crossed the hills. I also obtained a sketch of the mountains to the northward, Mount Sabine, or as I had myself named it from its peculiar form, "The Steeples," standing out quite distinct from the rest. I may here say, that it was in the neighborhood of this mountain, that Capt. Palliser, following the old Emigrant Pass which he had entered at Bow river, emerged from the mountains after a six or eight days' journey; he then, without however coming to the mouth of the Wigwam branch of the Kootanie river, the true entrance of the pass, recrossed by the Kootanie Pass, which I had previously explored.

I found the Kootanies communicative, and from them gathered the following information:—

That Colville, an American settlement on the Columbia, was about eight or ten days' journey with pack horses, and that they could descend to it by the river in canoes, but there were too many falls and rapids to admit of its being ascended; that the Flathead River, which I followed up in the mountains, runs to the south and joins Clark's Fork of the Columbia, in which is the Flathead Mission, which they described as three days' riding south of this; that there are large lakes to the northwest of the Kootanie Post, from one of which a small river flows and joins the Kootanie Fork, before it falls into Clark's Fork.

They also told me that there was a pass entering the mountains a little to the southward of their camp, and which came out on the east side near the Chief's Mountain; that there were long hills, but not so steep as the Kootanie Pass, and that they used it sometimes when the horses were heavily loaded. This information of another pass* in a portion of the mountains that I knew should be explored, caused me at once to decide on recrossing the mountains by this pass, although I knew that it must be wholly or partially on American ground, I therefore prevailed upon a Kootanie to accompany the party across as guide.

There are some considerable tracts of the Tobacco Plains which are prairie; the grass however, does not grow close and thick, but in small bunches with bare ground between, and the pasture is nothing to be compared to that at the base of the mountains on the east side. This is perhaps chiefly owing to the nature of the soil, which in the latter case, is a black mould, while on the Tobacco Plains it is sandy, and in most parts stony; at this season the grass was quite dried up and yellow.

As to the Kootanie Indians, their language at once strikes one as being most guttural and unpronounceable by a European, every word appearing to be brought up with difficulty from their lowest extremities.

They are nearly all baptized Roman Catholics, and are most particular in their attendance at morning and evening prayers, to which they are summoned by a small hand-bell. They always pray before eating. On the Sunday that I spent with them, their service, in which is a good deal of singing, lasted a considerable time; one of their number preached, and seemed to be well attended to.

Their food at this season appears to be almost entirely berries, namely, the "Sasketoom" of the Crees, a delicious fruit, and a small species of cherry; also a sweet root, which they obtain to the southward.

They grow some little wheat, and a few peas; a patch of the former, about forty yards square, which I saw near their camp, although rather small headed, looked well, a proof that this grain thrives in latitude 49° at an altitude of 2500 feet above the sea.

They possess more horses than any Indians I have seen or heard of on the east side, a camp of only six tents, having about 150, old and young. They also, in their treatment, are kind to, and show some knowledge of the animal. They are adepts at throwing the lasso, being brought up from their youth to its use. They possess a certain amount of domestic cattle, six tents having twelve or sixteen head; and I heard of some individuals at a distant camp, who owned as many as twenty or thirty each.

They are perfectly honest, and do not beg, qualities which I have never before met with in any Indians. I extract the following from my journal, written on the spot:—"On taking leave of the Kootanies, with whom I have been camped for nearly a week, it is but justice to say, that they have behaved in a very civil and hospitable manner, and although our clothes and other articles have been lying about in all directions, we have (with the exception of some hide lines, moccasins, and other articles of leather, which the half-starved dogs have eaten) not lost a single article." Whether this honesty is to be attributed to the knowledge of christianity spread among them by the ministers of the

Ioman Catholic church, or whether it is innate in them, I can nly say that it is a great contrast to the effect produced by the iissions in the Indian territory on the east side.

The Tobacco Plains form the country of the Kootanies, but very spring and fall they cross the mountains to the Saskatcha-'an Plains for the purpose of killing buffalo; they return with ipplies of dried meat, &c., with which they trade for blankets, nives, tobacco, &c., with the Hudson's Bay Company's traders ; the Kootanie Post. They also sometimes cross during the .tter part of winter, when there is sufficient crust on the deep iow of the mountains, on snow shoes, also for the purpose of otaining provisions, for there is little or no game on the west de.

On the 2d of September, I set out on my return journey across ie mountains. The morning was clear and sharp, the ther-iometer being two degrees below freezing. After I had lost ght of the Kootanie camp, and was riding ahead of my party n a S.S.E. course over undulating prairie, I felt satisfied that I ad done all that came under the spirit of my instructions, and 'as happy to be able to recross the mountains by another unex-lored route; my only regret was that this time it was not my ite to see the Pacific.

Leaving the Tobacco Plains at a point where they were pretty hickly wooded we followed a narrow trail, which, turning the outh end of Galton's Range, followed up a small creek towards he north end. We crossed a considerable mountain stream oming down a valley from the north, which as it may be of use o the Boundary Commission, I have taken care to mark, and amped at an altitude of 4070 feet. The following day we crossed, oon after starting, some high land, and then descended for the emainder of the day through thick woods till we arrived in the 'alley of Flathead River. The day after we descended by suc-essive steps to the Flathead River, where it is joined by a creek rom the N.W., here I remained till noon for the purpose of fix-ng the position of this part of the river, which was just 25 miles outh of where I had fallen upon it in my progress westward. Several peaks of the mountains showed well from this valley, .nd I did not lose the opportunity of sketching. A storm com-ng on drove me to camp earlier than I had intended. We alted on the creek spoken of, and only about half a mile south of the boundary, which according to careful bearings, crosses ust over a mountain, which itself has its length nearly in the xact direction of the line. Much rain fell in the afternoon and y the next morning, Sunday, had changed for snow which con-inued nearly all that day, giving the mountains a good white oat.

On Monday the 6th of September, immediately on starting at 6 A. M. we regained British ground; we travelled up the creek till 10, when we halted for breakfast. It was cold, raw, and clouded. Here we found that the Kootanies, four men and two women, with whom we were travelling, and who had camped here on Saturday, had started this morning for the traverse of the mountains. Suspecting that we had a good days' work before us, I delayed as little as possible at breakfast, and in less than an hour and a half we were again under weigh travelling up the course of the creek, which has some picturesque falls and cascades, caused by the inclined strata of red shale and sandstone. After two or three miles we began a steep ascent, and were soon on ground entirely covered with snow, in which the tracks of the Kootanies who had gone before us were visible. We passed along the edge of a very steep hill, and it was as much as the horses or ourselves could do in some places to keep footing. We now descended, crossed a thickly wooded gully and then commenced the ascent to the water-shed, through thick wood. The snow increased in depth as we ascended, until on arriving at the crest it was two feet on the level, and in places heaped up to double that depth. It was cold work trudging through the snow in thin leather moccasins without socks; and to make matters worse it was blowing and snowing all the time. I however on arriving at the water-shed, with the assistance of the Indian "James," whom I always found most willing, unpacked the horse with the instrument boxes and obtained a reading of the barometer, which gave an altitude of 6030 feet. We ascended *along* the ridge about 100 feet more, and then by a zigzag track commenced a steep descent. It was not however very bad, and we soon arrived at a small mountain torrent flowing eastward, thus regaining the waters of the Atlantic after an absence of sixteen days. The trail continued mostly through woods down the valley due east. The rocks on the tops of the mountains on either side were often of very curious shapes, and the strata in places much contorted; there were also some magnificent cliffs, and the cascades of snow water falling down the narrow gullies, added motion to the grandeur of the scene. The snow gradually decreased as we descended. On arriving at the spot where the valley joined another, I found the Indians camped on a patch of prairie, where I was glad enough to let my horse free, as we had travelled this day from six to six, with a halt of only 1½ hours.

The horses had the first half of the following day to rest, and I took the opportunity of testing my aneroid barometer by the boiling water apparatus, making the ordinary observations, and taking a sketch of a very peculiar peak just above our camp. After two hours travelling on level ground along Red-stone

reek, we emerged on the Saskatchawan Plains, just six geo-
raphical miles north of the 49th parallel, and camped at Water-
m Lakes two miles east of the mouth of the pass.

The position of the Waterton Lakes, as will be seen on the lan, is just where the offset range, before spoken of, strikes out the eastward from the main chain, having the Chief's Moun- in at its extremity. The uppermost and largest of these lakes, es in a gorge in the mountains, and is crossed by the boundary ne; the scenery here is grand and picturesque, and I took care make a sketch from the narrows between the upper or south- rnmost and second lake.

I was here fortunate enough to discover a stunted species of ine which M. Bourgeau, the botanist of the expedition, had ot obtained. I gave him the specimen of this as well as of some rns and other plants which I had collected.

I was much struck by the comparative greenness of the prai- es on this side, after the burned-up appearance of the Tobacco 'lains, which we had left but a few days before.

I remained camped at this pleasant spot two whole days for ıe sake of the horses, and in order to examine more carefully ıe nature of the country. Game was abundant, including rizzly bears, and we obtained both fresh meat and fish. The out and pike in the lakes were of large size.

The Chief's Mountain was not visible from the camp, but I btained a good view of it from a knoll on the prairie about our miles distant, which with my previous bearings enabled me lay it down, and curious enough, the boundary line passes ust over this peculiar shaped mountain, which stands out in the lain like a landmark. I also made a sketch of it.

It will be seen that some of the waters of the Saskatchawan ake their rise from the offset range at the boundary line, and rom information gained from the Indians, I believe there is a ributary of the South Branch, which rises to the southward of he Chief's Mountain, this may be the Bull-pound River of Ar- owsmith; if so, this offset range has nothing to do with divid- ng the waters of the Missouri and Saskatchawan, and some of he waters of the latter must come from American ground.

We experienced a gale of wind from the southwest, on the ight of the 7th, which on the following morning ceased very uddenly, and an opposing wind from the north brought rain nd snow, which gave another coating of white to the mountains. This corner of the mountains appeared to be a very windy spot, nd when it was not blowing much on the plain, a strong breeze ame from the south down the gorge in which is the upper Wa- erton Lake.

On the 10th of September, I turned my face towards Fort Ed- nonton, the previously appointed winter quarters of the expedi-

tion, which lay more than three hundred miles to the north, and as will be seen on the plan, passed several creeks, and over a country mostly prairie. I remained at the Forks of Belly River on Sunday the 12th. From this place I visited a camp of forty-five tents of Blackfoot Indians, accompanied by one of my men, and "James," the Cree Indian. I was received with the usual hospitality, and having expressed a desire to change a horse or two, I had no trouble the following morning in exchanging one and buying another for ammunition, tobacco, blankets, old coat, &c. This tribe has the credit of being dangerous, but from what I have seen of them, I consider them far better behaved than their more civilized neighbors, the Crees. I made it a rule never to hide from Indians, and, although I had but a small party, to go to them as soon as I knew of their proximity. I also always told them for what reason the British Government had sent the expedition to the country; and I never failed to receive manifestations of good will, neither was there one attempt made to steal my horses, a practice only too prevalent among the Indians of these plains.

I need not describe my northward journey; suffice it to say that I kept to the east of my former track, along the base of the mountains, except when I turned in for the purpose of raising the cache. I rested at Bow River on Sunday the 19th, travelled over prairie till crossing Red Deer River, the other fork of the south branch of the Saskatchawan, on the 23d; then, passing through a partially wooded country, which I had surveyed in the summer, arrived at Fort Edmonton on the north branch, on the 29th of September.

In this account of the return passage of the Rocky Mountains, by what I have called the Boundary Pass, I have not entered into such details as in the case of the Kootanie Pass, because, as will be seen by the accompanying plan and sections, more than one-half of it lies in American ground; but I have given the same amount of attention to the mapping of it, as I considered a knowledge of that portion of the mountains would be of service to the International Boundary Commissioners at present engaged on the west side. Moreover, I do not consider the Boundary Pass so well suited for the passage of a railroad as the Kootanie Pass.

It will be perhaps noticed that I have said nothing concerning the fitness of the Kootanie Pass for a waggon road. My reason is simply that where a railroad can be constructed, a waggon road can also be made; without considerable expense a road could not be made to pass *over* the two high points, (through which a railroad would tunnel,) in the line of the pack-horse track followed by me; but I have no doubt by taking more circuitous routes, both of these heights might be passed by slopes

adapted for wheel carriages. In other parts the road would follow the line proposed for the railroad.

I have not mentioned the existence of two other passes across this portion of the mountains, called the "Crow-nest" and "Flathead Passes," the former in the British, and the latter in American territory.

The Crow-nest Pass, of which I have marked the general direction on the plan, follows up Crow-nest River, a tributary of Belly River, into the mountains, and gains the west side near "The Steeples." By report of the natives it is a very bad road, and seldom used. I observed the old trail coming in from the plains on the left bank of Crow-nest River.

. The Flathead Pass enters the mountains at the 49th parallel of latitude, follows the west shore of Lake Waterton, and gains Flathead River, which it follows to the Flathead Mission on Clark's Fork of the Columbia, about 80 miles S. by E. of the Kootanie trading post. It is used by the Flathead Indians when crossing to the Saskatchawan Plains for the purpose of obtaining buffalo meat.

Fort Carlton, Saskatchawan River, December 15, 1858.

APPENDIX.

[Extract from the address of Sir R. I. Murchison at the anniversary meeting of the Royal Geographical Society, May 23, 1859. p. 103.]

Palliser Expedition.

British North America.—The important results of the exploring expedition under Captain J. Palliser, as communicated by the Colonial Office, and as dwelt upon in awarding the Founder's Gold Medal to that officer, have necessarily given great satisfaction to us, proceeding as they do from men who were especially recommended for this public service to Her Majesty's Government by our Society as well as by the Royal Society.

When Captain Palliser first proposed to make this exploration, one of the main points of interest to geographers was a survey of that part of the Rocky Mountains to the north of the United States boundary which separates the great tracts now named British Columbia from the eastern mass of British North America. Her Majesty's Government deemed it, however, of paramount importance that, in the first instance, the nature of the ground between Lakes Superior and Winnipeg should be accurately surveyed, in order to set at rest all questions of colonization as dependant on the possibility of making practicable routes of communication. For example, whether the Canadas might be brought into profitable communication with the Red River Settlement. The remoter or more western explorations were destined to develop the true nature of the great prairie

region, as watered by the North and South Saskatchawan rivers and their affluents. Collaterally, it was resolved, if possible—and mainly at the instance of this Society—to determine the elevation of the Rocky Mountains in those parallels of latitude, and to point out the passes in them by which communication might be opened out between the vast country occupied by the Hudson Bay Company and the great British seaboard on the Pacific.

In the award of the Patron's Medal to Captain Palliser, allusions have been made to some of the principle results obtained by the researches of the expedition under his orders. But I should not do justice to the leader and his associates, nor to my own feelings, were I not to add a few words of explanation and comment. The first year's labors were necessarily of more importance to the Government than they could be to geographers and naturalists. The great object was to determine the capability of establishing an intercourse between the rocky region of Lakes Superior and Winnipeg on the east and the rich prairie countries on the west; and though astronomical, physical, and magnetical observations of considerable importance were made—these countries being to a great extent known before, and their outlines being monotonous—that portion of the survey created but slight interest among us.

Not so when the Rocky Mountains, to which we had specially directed attention, came to be surveyed.* On proceeding from Fort Carlton, Palliser showed his good sense in approaching these mountains from the rich Buffalo prairies midway between the North and South Saskatchawan. An experienced buffalo-hunter himself, he knew that if his men were not well supplied, by no efforts, however well directed, could they succeed. Accordingly, having established a good base, and having secured abundant provisions at Slauter Creek, he divided his force into three parties. Leading one of these himself across the Kananaski Pass, and returning by the Kootanie Pass in north latitude 49¼°, and directing Captain Blakiston to explore the still more southerly or boundary Pass, he sent Dr. Hector to traverse the chain by the Vermilion Pass, and to explore, as a geologist and naturalist, the much loftier mountains into which the chain rises in its trend to the N.N.W. This division of his forces well merited, therefore, the expressions used in the award which has been sanctioned by the Council.

The marked success of the survey accomplished by my young friend Dr. Hector has been peculiarly gratifying to me, inasmuch as I had answered for the capacity he would exhibit in applying his scientific knowledge. Thus, in addition to the determination of latitude, longitude, and the altitude of the mountains and two

* Dr. Hector had, by directions of his chief, made a successful foray in dog-sledges to the eastern edge of the Rocky Mountains during the winter, in which he procured men and horses.

of their passes, Dr. Hector presents us with a sketch of the physical and geological structure of the chain, with its axis of slaty subcrystalline rocks, overlaid by limestones of Devonian and Carboniferous age, and flanked on the eastern face by Carboniferous sandstone, representing, probably, our own coalfields, the whole followed by those Cretaceous and Tertiary deposits which constitute the subsoil of the vast and rich prairies watered by the North and South Saskatchawan and their affluents. His observations on the erratic or drift phenomena are also curious and valuable.

Prevented by his instructions from descending into the valleys of Columbia, and there to ascertain practicable routes to the far west, which he will look out for during the present summer, Dr. Hector, though so severely injured by the kick of a horse as to be incapacitated from moving for some days, contrived so to travel northwards as to round the base of the loftiest mountains of the chain before he returned to his winter-quarters in October, after an absence of eighteen weeks from his chief, but laden with valuable geographical and geological knowledge.

In this survey he had the merit of showing that the Vermilion Pass—which is less than 5000 feet high, and therefore 1000 feet lower than any other known pass of the Rocky Mountains—had another decided advantage over them, inasmuch as its western slope, from the summit level of the horse-path, is so little steep that its explorer has no doubt that even a road for carts may be there established. The descents westward, or into the drainage of the Columbia, in the other passes are exceedingly steep; and according to Captain Blakiston, the Kootanie Pass can only have a railroad made along it by the formation of tunnels of several miles in length, and by encountering the difficulty of the steep western gradient of 194 feet per mile.

Another singular natural feature of comparison is, that whilst the Vermilion Pass is less that 5000 feet above the sea, the adjacent mountains on the north rise to near 16,000 feet, showing the great depth of the gorge. On the other hand, in the range beyond the British boundary, to the south, and where no peak (not even that of Fremont) exceeds 13,000 feet, the passes range from 6000 to 7000 feet high.*

* In anticipation of what may hereafter be published in the 'Journal of the Royal Geographical Society,' the reader is refered to the papers presented to Parliament in April, relative to the "Exploration by Captain Palliser of that portion of British North America which lies between the northern branch of the River Saskatchawan and the frontier of the United States, and between the Red River and Rocky Mountains." These printed documents are accompanied by a map, executed by Arrowsmith, from the surveys of the Palliser expedition, together with despatches of the leader and officers under his command, and tables giving the calculations of latitude and longitude by which the positions of places were fixed. An additional paper and map on the southern part of the Rocky Mountains near the American boundary, as prepared by Captain Blakiston, who had quitted the expedition, has very recently been sent to the Society, with the notice from the Secretary of the

Whether one of the heights called Mounts Brown* and Hooker by Mr. Douglas, in honour of our eminent botanical contemporaries, be still higher than the Mount Murchison of Palliser and Hector, it is certain that the chain diminishes rapidly in its trend from this lofty cluster to the north. We know, indeed, that Mackenzie, the first great explorer of those regions, passed through the range in north latitude 56°, at a comparatively lower level. Again, we further know that in proceeding northwards these mountains dwindle into insignificance before they reach the Arctic Ocean.

It will be recollected that seven years ago Captain M. H. Synge of the Royal Engineers, who had been quartered in the Canadas and had made excursions into the adjacent western territories, being deeply imbued with the importance of the original observations of Mackenzie, and attracted by his glowing description, made a warm appeal in favor of the establishment of a line of communication between the Atlantic and Pacific, by passing from Lake Athabasca and the Peace River, thence traversing the Rocky Mountains on the parallel followed by Mackenzie. But that scheme must now, I apprehend, give way before the

Colonies that it was not to to be looked upon as an official communication until sanctioned by Captain Palliser.† These last-mentioned documents, which seem to me to be also ably prepared, have not yet been laid before the Society. The public will soon possess an excellent map by Arrowsmith, in which all the new discoveries are inserted. This map is entitled 'The Provinces of British Columbia, Vancouver Island, with portions of the United States and Hudson Bay Territories.'

I was recently informed by my friend the Right Hon. Edward Ellice that the geographical position of these passes was laid down many years ago upon a MS. map, at the instance of the Hudson Bay Company, by Mr. David Thompson. I have further learnt from Mr. Arrowsmith, with whom he corresponded, that Mr. Thompson explored the vast regions of the Hudson Bay Company in all directions during twenty-eight years, and projected the construction of a general map of the whole country between Hudson Bay and Lake Suprior on the east, and the Pacific on the west! It appears that the last six years of his labors were spent on the west side of the Rocky Mountains; it being important to note that his MS. maps were all made from actual survey, corrected by numerous astronomical observations. The largest affluent of the Frazer River in British Columbia, "the Thompson," justly bears the name of this great but little-known geographical explorer; and I therefore trust that there is no foundation for a report which has been spread, that it is proposed to substitute some other appellation for the name of this meritorious man. Beginning his astronomical observatiohs in 1792, Mr. David Thompson was in 1817 appointed the Astronomer of the North American Boundary Commission, and was upwards of eighty years of age when he died in Canada. In the words of Mr. Arrowsmith, "he has left no one behind him who is possessed of a tenth part of his acquaintance with the territories of the Hudson Bay Company, whose directors were duly sensible of his great merits." Whatever may be the fate of that remarkable Corporation, we must all admit that it has not only maintained British rights over wide tracts of North America, but has also, in addition to Thompson, produced some of the best geographical explorers of snow-clad Arctic countries, including our medallist Rae; whilst its dealing with the various fur-hunting tribes of Indians have been so equitable as to have maintained the attachment of these poor people, who under such influence have been preserved, instead of falling before the white man as in other parts of America.

* Mount Brown is said to be 16,000 feet high.

† This is the preceding Report.

horter passages across the mountains in a more southern paral-
el, and which will, it is hoped, bring a rich prairie country on he east into intercourse with our newly-discovered gold region n the west, as well as with Vancouver Island, the natural esources of which were brought before us by Colonel W. C. Grant. During the animated discussion which took place mong us in the year 1851, Mr. Asa Whitney, of the Uuited tates, in proposing his gigantic plan of an inter-oceanic railway, andidly told us that the best line of intercourse between the two ceans would be found within the British territories, and the Palser expedition has already gone far to demonstrate the truth nd value of his suggestion.

With a knowledge of the data acquired by the Palliser xpedition, men of ardent minds already contemplate the formaon of a railroad, or, if not, of a practicable route, which travrsing British possessions only, shall connect the Atlantic and 'acific Oceans. But when we reflect that the length of this line above 2000 English miles, and that the greater part of the route n the east will have to traverse wild and unpeopled regions, e cannot rush to hasty conclusions as to the practicability of ıch an enterprise. Neither ought we to deride a plan which ıay be ultimately called for when British Columbia and Vanouver Island shall have risen into that importance which they ıust attain as British Colonies. For, it is now ascertained, that ıe tract lying between the North and South Saskatchawan on ıe east is one of great fertility, where no intense cold prevails, ıd that, once through the Rocky Mountains, the traveller enters country of cedars and rich vegetation, in which even wheat ıay be grown at heights exceeding 2000 feet above the sea. In ıe mean time we need, at all events, have no hesitation in ssuming that the electric telegraph will, ere long, be at work cross British North America.

Believing it to be of the deepest geographical importance, that ıen who have distinguished themselves as Palliser and his assoiates, should not, through a misplaced economy, be held to their riginal instructions, and be forced to return homewards by etracing their steps from Fort Edmonton, over the previouly eaten tracts of North America and the United States, I have ıad great pleasure in supporting the request of the gallant leader f this expedition and of his associate Dr. Hector, that they might e allowed to wend their way home next summer by again travrsing the passes in the Rocky Mountains, and thence to explore he great intervening tracts of British Columbia, including the uriferous region of Frazer River. I am happy to say that Sir Edward B. Lytton readily complied with this request, and that he Palliser expedition is thus about to establish fresh claims ıpon our approbation.

ART. XXXVI.—*On Nitride of Zirconium;* by J. W. MALLET, Prof. Chemistry in the University of Alabama.

(Read before the Amer. Assoc. for the Adv. of Science, August, 1859.)

AMONG the most interesting facts brought to light by the recent researches of Wöhler and Deville upon silicon and the allied elements is that of the strong affinity of these bodies, when free, for nitrogen. Several of the nitrides which result from this affinity have been described—as those of boron, silicon, titanium, and tantalum. I have now to add to the list *nitride of zirconium.*

This substance was obtained under the following circumstances. The ease with which silicon and boron may be crystallized by exposing the elements in the amorphous state to a very high temperature, in contact with aluminum, which when fused seems to act the part of a solvent, led very obviously to the expectation that other related elements might also be obtained in crystals by this process. Titanium and zirconium suggested themselves as specially worthy of experiment in this direction. With the exception of the bare notice* that Deville, by heating aluminum in a porcelain tube traversed by a mixed current of hydrogen and a vaporized chlorid, had obtained crystalline silicon, boron, carbon, *zirconium*, and *titanium*, I have seen no account of the preparation or properties of the last two. Deville and Wöhler have indeed stated at a beginning of a paper† on nitride of titanium that this substance was first noticed by them in the attempt to procure titanium itself in a compact state—but the means proposed for the attainment of the latter object are not mentioned.

A quantity of amorphous zirconium and titanium was prepared by heating the potassio-fluorids with sodium in an atmosphere of hydrogen, and it then remained to be seen whether the metals could be brought into the crystalline state by exposure to intense heat in contact with aluminum. A small piece of aluminum was placed in the cavity of a lime crucible (of the kinds proposed by Deville), and was then surrounded with black pulverulent zirconium, which latter was pressed down as closely as possible, and covered by a layer of quick-lime in powder, also strongly pressed. A stopper of solid lime was fitted to the opening, and the whole was exposed for about an hour to the heat of a small blast furnace capable of melting platinum.

After cooling, the crucible was removed from the furnace, and was found to be *slightly cracked.* This no doubt occurred at the beginning of the experiment, and was caused by the too

* Paris correspondence in Amer. Jour. Sci., May, 1856, p. 404.
† Ann. d. Chem. u. Pharm., August, 1857, S. 230.

pid application of the blast. On breaking the crucible across, e interior presented the appearance of a porous mass of dark ay color, through which globules of aluminum were scattered. iis mass was placed in dilute muriatic acid, and began in part dissolve with effervescence.

A few iron-black shining scales, like those of graphitic silicon, parated out, and these perhaps constituted the original object the experiment—that is, were zirconium in the form corres- nding to graphite. The color and lustre were very like those silicon in this form; the scales appeared however to be thin d flat rather than needle-like; no definite angles or planes uld be seen under a high microscopic power. In another ex- riment these scales were obtained in larger proportion, exclud- g, I think, the likelihood of their being silicon itself, derived her from the aluminum or the lime; the absolute amount, wever, was very small, and no chemical examination of these ales could be made.

As the acid continued to act upon the mass taken from the ucible, bright surfaces and little veins of golden color and lus- made their appearance, and here crystalline structure be- me apparent under a common pocket-lens. It was necessary, wever, to use a pretty high microscopic power in order to ing out the form of the very minute specks which formed these ld-like crusts; with a magnifying power of 400–600 they were en to consist of distinct cubes, the largest of which were not ore than the one-hundredth of a millimetre on the side. The lor and lustre were those of gold, and the appearance of some the microscopic specimens was very beautiful, the little cubes ing imbedded in a colorless glassy matrix, probably a com- und of zirconia and lime. One was reminded by them of the anium cubes of the iron smelting furnaces.

This gold-colored substance was but very slightly acted on by e common acids, even the nitro-muriatic, or by the alkalies in lution; fused with caustic potash it gave off ammonia in undance, thus proving the presence of nitrogen. Its compo- tion was not determined quantitatively, owing to want of suf- ient material, for much of the zirconium had combined with e oxygen of the air, but a part uniting to the nitrogen. The tride in contact with water at common temperatures, appeared undergo in some slight degree the same decomposition that eville and Wöhler* have remarked in the case of nitride of licon, ammonia being formed.

It having been shown that zirconium is capable of uniting di- ctly with the free nitrogen of the air, one or two experiments ere made with gaseous compounds of nitrogen.

* Ann. d. Chem. u. Pharm., Mai, 1859, S. 249.

Amorphous zirconium was heated in a Bohemian glass tube up to the temperature at which the latter softened, a stream of ammoniacal gas being passed through it. At a low red heat there suddenly appeared a bright glow, spreading rapidly over the metallic powder, and then disappearing; this was probably owing to the presence of a little hydrate of zirconia, the water of which, as Berzelius has shown, yields oxygen to the metal when heated. After cooling, the tube was found to contain a dark gray, perfectly amorphous powder. Under the microscope it could be seen that the gray color was due to a mixture of white and black particles; the white being no doubt zirconia, produced partly by the presence of hydrate as just noticed, and partly by the fact that the ammonia had not been perfectly dried. The gray powder was gently heated in the air to drive off any free ammonia, and then fused with caustic potash; it gave off ammonia in abundance. Heated to low redness in the air, it took fire, glowed brightly, and even continued to burn when removed from the lamp-flame. It burned almost white, and when afterwards fused with caustic potash, gave only traces of ammonia.

A similar amorphous gray powder was obtained by heating the anhydrous chlorid of zirconium in gaseous ammonia, chlorid of ammonium and hydrochloric acid volatilizing. Unfortunately the ammonia was not quite dry, and in consequence the color of the powder was light, showing the presence of but little nitride; on fusion with caustic potash but little ammonia was given off.

Lastly, pulverulent zirconium was heated to a bright redness in a tube of Bohemian glass, through which passed a stream of dry cyanogen. The glow alluded to above appeared and spread over the mass. On cooling, an amorphous powder was obtained, of black color with a shade of chocolate-brown; this, after gentle heating in the air, was fused with caustic potash and gave off ammonia in large quantity. Strongly heated in the air, the powder took fire, and burned nearly white; after burning, it gave with caustic potash slight but distinct traces of ammonia. The black powder was not dissolved by muriatic acid, and appeared to be scarcely affected by the nitro-muriatic acid. Hot oil of vitriol seemed to act on it but slightly and very slowly; the acid became brown, and a little gas, apparently sulphurous acid, was given off; hence it is probable that this powder contained carbon—was perhaps a nitro-cyanid.

These experiments would seem to show that—

(1.) Zirconium, like titanium, silicon, and boron, has a strong affinity for nitrogen, is capable of removing it from some of its compounds, and will even unite directly with it when free and inert, as in atmospheric air.

(2.) The relation, thus indicated, of zirconium to titanium and silicon, supports the evidence afforded by the late experiments

Deville and Troost on the vapor-density of chlorid of zirco-
m, which appears to have the formula $ZrCl_2$, analogous to
l_2 and $SiCl_2$.

3.) Zirconium has probably not quite as strong an affinity for ogen as some of the other elements named above. As pre- ed from ammonia or cyanogen at least, its nitride burns when ngly heated in the air, like the nitride of niobium of H. e,* and perhaps the nitrides of tungsten and molybdenum;† contact with water nitride of zirconium is probably subject low decomposition, like nitride of silicon.‡

4.) It would be desirable to examine the action of chlorine n this nitride of zirconium at a high temperature, so as to rtain whether cyanogen may exist in any of the specimens pared by different methods; also to endeavor to obtain the npound in crystals of larger size, and to get a qualitative lysis of it in a state of purity.

T. XXXVII.—*On the Atomic Weight of Lithium;* by J. W. MALLET, Prof. Chemistry in the University of Alabama.

(Read before the Amer. Assoc. for the Advan. of Science, Aug. 1859.)

N a paper read before the American Association for the Ad- cement of Science in August, 1856, I endeavored to show t the equivalent of lithium, which has been usually taken, on authority of Berzelius, as 6·5 (=81·25 on the oxygen scale), 6·6 (=82·50), is in fact considerably higher, and may be as- ned =7· (or 87·50).

The error involved in the older determinations was noticed as to the fact, observed by Marignac and others, that when a phate (the salt analyzed) is precipitated by an excess of orid of barium, traces of the latter are thrown down with the cipitate and cannot be removed by washing, thus bringing the quantity of sulphuric acid greater, and the atomic weight the base less than the truth.

My own results were obtained by the method used by Pelouze determining the equivalents of sodium and barium, namely, precipitation of chlorid of lithium by a solution of silver of own strength. In this way the equivalent of lithium was nd by three experiments =86·93, 86·96, 86·45, or in the mean 78 (or 6·95 as referred to the hydrogen unit).

Since the publication of the above result, it has been con- ned by Dumas, who, in one of his recent papers on the equiv- nts of the elements, states that he has found that of lithium

Ann. d. Chem. u. Pharm., Mai, 1856, S. 140. † Ibid., Feb. 1858, S. 259.
Ibid., Mai, 1859, S. 249

$=7\cdot$, without however giving the details of the experiments on which this number is based.

On the other hand, Troost, in a paper upon the general history of lithia and its salts,* has objected to the method by which my determination of the equivalent was made, and has returned to a number near that originally given by Berzelius. Troost states that chlorid of lithium on being heated in the air loses chlorine and takes up oxygen, so that it must give by the method of Pelouze an atomic weight for the metal higher than the truth. This fact was distinctly noticed in my former paper, and it was stated that the decomposition might be prevented by addition of a little pure sal-ammoniac to the chlorid of lithium before heating. Troost objects to this, not that he has proved the method of correction defective, but that we cannot in the end tell whether the salt contains its full proportion of chlorine or not, unless the true equivalent of lithium—the constant we are in search of—be known. But it is to be remarked that the product of the exchange of chlorine for oxygen is caustic lithia, exhibiting a strong alkaline reaction. I have twice or thrice prepared chlorid of lithium, adding sal-ammoniac, and igniting in a well closed platinum crucible, and have always found that several grams dissolved in a very small quantity of water (the salt is extremely soluble) gave not the slightest alkaline or acid reaction with the most delicate vegetable colors.

Troost himself adopts crystallized carbonate of lithia as the salt to be analyzed in order to determine the equivalent. He precipitates the carbonate, washes it thoroughly, diffuses it in water through which carbonic acid gas is passed until the salt dissolves, evaporates the solution until the carbonate is deposited as a crystalline powder, and dries this powder at 200°. He determines the lithia in one portion of the salt by evaporation with pure sulphuric acid, and the carbonic acid in another portion by noting the loss of weight on fusion with silicic acid. In this way he arrives at the number 6·6 (=82·5). No proof is offered that exposure to a temperature of 200° is capable of removing every trace of water and all carbonic acid over a single equivalent; yet, unless this be effected, the atomic weight of lithium will be brought out less than the truth. The same result will follow from the mechanical loss of the least drop of fluid during the effervescence of the carbonate with sulphuric acid or the subsequent evaporation of the sulphate of lithia; and, without feeling the slightest doubt of the manipulative skill of the French chemist, we must admit that, in so delicate a process as the determination of an atomic weight, the solution of a carbonate and evaporation of the solution—steps which are generally

*Ann. de Chim. et de Phys., [3], t. LI, p. 108.

looked upon as undesirable in the common course of analysis—should, if possible, be avoided.

I have recently made a new determination of the equivalent, deriving it now, from experiments upon the sulphate of lithia; applying, however, a method avoiding as I hope the source of error to which Marignac has drawn attention; an error which threw much difficulty in the way of his successful estimation of the atomic weights of cerium, lanthanum, and didymium. If we add a salt of baryta in excess to a solution of any sulphate, the precipitate usually contains a small amount of the soluble barytic salt, which cannot be washed out, and which therefore increases the apparent amount of sulphuric acid present, if the latter be calculated from the weight of the sulphate of baryta, supposed pure. On the other hand, if the soluble sulphate be in excess, it will mix with the precipitate to some extent, and thus the proportion of sulphuric acid may be brought out higher or lower than the truth, as the equivalent of the base under examination is lower or higher than that of baryta. So that, if we wish to determine the atomic weight of lithium, as Berzelius did, by mixing the solution of a known amount of sulphate of lithia with chlorid of barium and weighing the sulphate of baryta precipitated, we are not certain that the weight of the latter really corresponds to the quantity of sulphuric acid in the salt analyzed. The same objection applies to Marignac's analysis of the sulphates of cerium and the allied metals. He there noted the volume of a solution of chlorid of barium of known strength required to precipitate a weighed portion of the sulphate; when a precipitate ceases to form, more or less chlorid of barium may have been used than is really equivalent to the sulphuric acid present.

The amount of the above error, must however be constant if the sulphate precipitated, the salt of baryta used, and the circumstances of precipitation be all the same. If the same salt of baryta be used to precipitate *different* sulphates, it is probable that the amount of error will be different for each. But, if we take the sulphates of two very similar and closely related bases, it is probable that *the difference* in the amount of error will be very small. These considerations have led to the following method for determining the equivalent of lithium.

Sulphate of lithia was prepared, with all possible care, from the carbonate, and tested rigidly as to its purity. Two separate portions (A, 1, and 2,) of this salt were rendered anhydrous by cautious application of a heat below redness, and accurately weighed. Two similar portions of perfectly pure sulphate of *soda* (B, 1, and 2,) were dried and weighed with equal care. And, lastly, two portions of pure sulphate of *magnesia* (C, 1, and 2,) were in like manner dried and weighed. Soda and magnesia

were chosen for comparison with lithia because the last-named base seems in most of its relations to hold an intermediate place between the former two, with which it is closely allied. Chlorid of barium was also prepared with all the precautions needed to ensure its purity, precipitated twice from its aqueous solution by alcohol, and recrystallized three or four times. It was at last obtained as a fine crystalline powder by stirring the hot saturated solution as it cooled, and this powder was allowed to dry spontaneously in the air at a temperature of about 80° F. Thus prepared, the salt—as Marignac has shown—is not altered in weight by further exposure to air, its theoretical composition is $BaCl+2HO$, the precise amount of water actually present was probably a little greater, owing to the mode of drying, but was unimportant under the conditions of experiment adopted.

For each of the six weighed portions of sulphates mentioned above, the quantity of chlorid of barium needed for exact precipitation was calculated, assuming the equivalent of sodium $=23$, that of magnesium $=12$, that of lithium $=7$, and that of barium $=68{\cdot}6$, and considering the chlorid of barium as containing strictly two atoms of water. Six portions of the last-named salt were weighed out (at the same time), each less than the amount calculated by one or two centigrams. Each was dissolved in 200 cubic centimetres of hot water, and added to its corresponding portion of sulphate, likewise dissolved in 200 cub. centim. of hot water. The fluid and precipitate in the six beakers were well stirred, and left to settle.

A solution was now prepared of 1 gram of the crystallized chlorid of barium (weighed out at the same time with the larger portions) in 1 litre of water, each cubic centimeter corresponding therefore to 1 miligram of $BaCl+2HO$. With this standard solution, dropped from a pipette whose degrees $=\frac{1}{5}$th of a cubic centim., the precipitation of the fluid in each of the six beakers was completed—the amount of chlorid of barium thus employed was noted, and added to the weight of the main portion originally taken. At first it was easy to observe the formation of a precipitate on each successive addition of the chlorid of barium solution, and subsidence took place quickly; but, as the point of exact neutralization was more and more nearly approached, each observation became more difficult, and hours and even days were required in order to observe the production of a cloud by each drop added, or to get the fluid clear again for another trial. When the last addition of chlorid of barium altogether failed to produce a precipitate, a single drop of a solution of sulphate of soda was added, and the formation of a cloud noticed.

In this way the following results were obtained:—

A, 1.—3·8924 grm. of LiO, SO_3 required for complete precipitation 8·6323 grm. of $BaCl+2HO$ as used.

A, 2.—4·6440 grm. of LiO, SO_3 required 10·2940 grm. of BaCl+2HO.

B, 1.—5·0675 grm. of NaO, SO_3 required 8·6920 grm. of BaCl+2HO.

B, 2.—5·1107 grm. of NaO, SO_3 required 8·7688 grm. of BaCl+2HO.

C, 1.—4·3380 grm. of MgO, SO_3 required 8·8318 grm. of BaCl+2HO.

C, 2.—4·6625 grm. of MgO, SO_3 required 9·4872 grm. of BaCl+2HO.

Calculating now from B, and C, the amount of crystalline chlorid of barium necessary to precipitate *an equivalent* of NaO, SO_3 or MgO, SO_3, we get the following numbers, which represent what may be called *the practical equivalent* of the chlorid of barium as actually used.

		Means.	
From B, 1.	121·78	121·80	121·96
" " 2.	121·82		
" C, 1.	122·15	122·12	
" " 2.	122·09		

The theoretical equivalent of BaCl+2HO being 122·1—the presence of any water over the normal two atoms tends to raise the practical equivalent—the presence of any BaCl in the precipitated BaO, SO_3 has the same effect,—the presence of either of the soluble sulphates in the same precipitate leads to an opposite result. From this practical equivalent of chlorid of barium and the results given above under A, 1, and A, 2, we may calculate the equivalent of lithium. If we adopt for chlorid of barium the number 121·80—that obtained by the precipitation of NaO, SO_3—we have for A, 1,

$$\frac{3{\cdot}8924+121{\cdot}80}{8{\cdot}6323}=54{\cdot}92=\text{LiO, SO}^3$$

$$54{\cdot}92-48(\text{SO}_3+\text{O})=6{\cdot}92=\text{Li}$$

and for A, 2,

$$\frac{4{\cdot}6440+121{\cdot}80}{10{\cdot}2940}=54{\cdot}95=\text{LiO, SO}_3$$

$$54{\cdot}95-48=6{\cdot}95=\text{Li}.$$

The mean of the two results is 6·935.

If we take for chlorid of barium the number 122·12—derived from the experiments with MgO, SO_3—we get by a similar calculation,

From A, 1, ... Li=7·07.
" " 2, ... Li=7·09.

or, in the mean, 7·08.

Lastly, if we take the mean of the two numbers for chlorid of barium, namely, 121·96, we get for

A, 1, - - - - - - -	Li=6·99
" 2, - - - - - - -	Li=7·02

or, in the mean, 7·005.

Hence, we find, that the equivalent of lithium, as deduced from the mean results of the above experiments, comes out

6·935 (=86·69 on the oxygen scale)
7·080 (=88·49 " " " "
7·005 (=87·56 " " " "

or as we take the *practical equivalent*, or actual precipitating power, of chlorid of barium from the experiments with NaO, SO_3, those with MgO, SO_3, or the mean of the two, these numbers exhibiting close agreement, and obviously indicate 7· as the true equivalent of the metal. It will be observed that the above method is independent of a knowledge of the exact equivalent of barium, and uses chlorid of barium merely as a means of bringing sulphate of lithia into comparison with the sulphates of soda and magnesia—the equivalents of the two last named bases may be considered as ranking among those best established—and the small difference between *the practical equivalents* for chlorid of barium deduced from these two shows the probable extent of error involved in the assumption of the same constant in the precipitate of the sulphate of lithia.

While these results confirm those formerly obtained by the analysis of chlorid of lithium, I do not consider them of superior or perhaps even of equal value. The estimation of chlorine by the method of Pelouze is apparently one of the most simple and exact processes for the determination of an atomic weight which have ever been proposed, and it is, as I believe, fully applicable to the case of chlorid of lithium.

As the result of both sets of experiments we may fairly take the number 7· (=87·50) as representing the true equivalent of the metal.

Art. XXXVIII.—*Notes on certain Ancient and Present Changes along the Coast of South Carolina*; by Oscar M. Lieber, State Geologist, S. C.

It is very evident that remarkable changes have taken place on the coast of South Carolina during the present geological epoch; changes, which have effected or are yet, effecting very conspicuous alterations in the contour of the coast as well as in the hydrography of the immediate interior, and the elevation

and character of the land. Five or six prominent effects of change I think may thus be distinguished:

I. An ancient depression along our coast.

II. A total change in the course of the portions of the rivers near the coast.

III. A more recent superficial elevation of the coast and—

IV. Consequent gradual seaward extension of the coast.

V. A present depression of the coast and

VI. A southward translocation of our littoral islands.

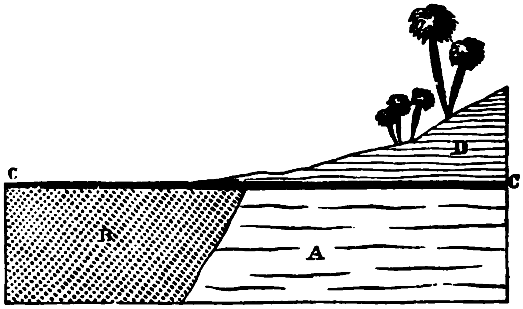
Of the ancient depression of the coast we find an indubitable proof in the piles of oyster shells accompanied by charred wood and Indian pottery, found in ditching the rice fields sometimes at a depth of five or six feet, and near the level of low tide at a distance of thirty miles frequently from the mouth of the river, (as at Mr. Langdon Cheves' plantation opposite Savannah). This fact also seems to indicate that the coast must, at the time that these oyster piles were formed, have been far nearer, for the distance from the sea would be too great to render transportation likely. It also shows the gradual rise of the land by surface accumulation, of which, of course, there are many other indications in the fertile alluvium of the rice-lands.

The formation of some of these rice-lands is itself connected with a remarkable change in the general character of the seaboard. Let us take Cooper river for instance, as that affords one of the most remarkable cases in the State. Any map of moderate accuracy will show that the length of this river bears no proportion to its width. At the same time it is accompanied on either side by wide bodies of alluvial accumulations, which could not possibly have had their origin in material derived from the adjacent country, which, with the solitary exception of an occasional bluff of eocene marl, (as at Mepkin), is a region of pure and coarse sand, whose effects, wherever it is washed into the rice-lands, is materially injurious.

The rice-lands themselves are composed of a rich tough loamy soil having at times a thickness of sixty feet (*d* in Fig. 2, B in Fig. 1), containing no visible organic remains—not even infusoriæ, as Dr. E. Ravenel informs me—but perfectly homogeneous in its composition. Upon this substance rests a stratum composed either of the remains of marsh grass or of drift-wood and bay-roots, &c., according as the surface is more or less exposed to the tidal inundations of salt water. This stratum is observed at C C in fig. 1. In those places where it is regularly covered by salt water, the accumulations of the whitened shells of dead mollusca are often visible even at a distance. C C is evidently a far newer formation than B and altogether distinct in its origin. There are cases, for instance close to Dr. E. Rav-

enel's residence, where the stratum, C C, may be observed to extend into the adjacent sand bank, while at another point on

1.



the same plantation the drift wood contained in this bed, was struck at a considerable distance from the edge of the bank. D, therefore, assumes the appearance of a drift-sand. A, may either represent earlier sand strata (probably post-pliocene, but containing no fossils), clearly marked, highly fossiliferous post-pliocene clays and marls, or the more durable eocene marl beds.

In some places the bed, C C, presents an extremely light, semi-peaty mass of greatly increased thickness (as on Savannah river: Mr. Cheve's plantation, &c.), when dry it ignites with the greatest ease, leaving scarcely any ash. Of this feature advantage has been taken to reduce it to the level of the rice-fields now in cultivation, where its natural elevation and more inland position raises it above the tidal irrigation, it is then annually burnt off. For one year it will then yield a good corn crop, by repeating the operation its level is gradually reduced, and the land which it covers rendered available to rice-culture. (L. C's plantation.)

We have seen that the stratum, C C, often underlays the adjoining sand hills, while the far more massive bed, B, terminates abruptly on striking either the marl-bluffs or the solid sand-banks. C C, is therefore not the more recently accumulated part of B; but entirely independent.

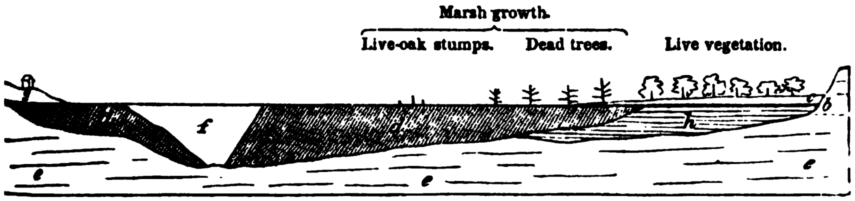
With rivers like the Savannah, the Santee and the Pedee we find the source of the mass B at once explained by the presence of those water-courses. But with rivers like the Combahee, Ashepoo, and especially the Ashley, Cooper and Wandoh, no such existing source is visible. The present streams do not extend sufficiently far into the interior, nor do they drain sufficiently fertile regions to have been able to accumulate so very rich a deposit; yet they are the very ones, where this stratum is observable in its greatest development. If we notice the great ramifications of the swamps of this region, the solution, how-

ever, becomes apparent, and we are then taught that these rivers did at one time drain large portions of the back country, the Santee having probably at one time debouched into the Atlantic near Charleston. Subsequent driftings of the sands of the region have in part obliterated the boundaries of the connecting swamps, but over the greater distance we may yet trace them with considerable facility. The homogeneous unstratified character of the deposit, B, and the marked absence of drift-wood, appears to me to render it likely that it was the result of a gradual but constant sub-aqueous deposition of sand, and that such freshets did not occur in those days, which now transport trees and logs from the interior. We have ample and historical proof indeed that these fluvial inundations have greatly increased since the clearing and cultivation of the "Up-Country."

Where the bodies of land, to which we have just devoted our attention, are situated near the sea-coast, the horizontality of their surface affords us an exceedingly reliable guage, by which to determine the changes in elevation which take place on our sea-board.

In fig. 2 I have given an ideal section, which might represent a section across Cooper river. In this figure, *a b*, represents the

2.



medium level of the water, the level at half tide, *c* and *g*, are beds of sand (the sand hills at *g*,) which have in part drifted over the alluvial deposits represented by *d*. It is probable that on both sides of the river *f*, I have extended the sand *c g*, too far over the mass *d*, or rather have extended the latter too far beneath the former, for I have enjoyed no opportunities of studying the extreme lateral extent of *d*, *beneath* the sand, or the joint boundary of the older sand bed *h*, and of the marl beds *e*, beneath *d*. Undoubtedly the case presented in fig. 1 is the most common, and the eocene beds which appear in high bluffs on the east and show themselves in the bed of Cooper River, may therefore lie much nearer the surface on the west side, than I have here represented. This has however little to do with the question which we now approach.

It has been said that a gradual depression and submersion is manifest on our coast. This I have endeavored to exhibit in

fig. 2. Passing along from the river, we first observe a strip of marsh, containing no remains of a forest growth, next we come to a portion already entirely covered by the high tide, where the stumps of the most enduring trees—the live oak—may yet be seen. After this we enter another portion where the marsh growth is not universal, and in which pine and other trees, dead in part, though still standing, may be found. The soil is sandy. Leaving this we pass through a strip of dying forest into that which is still living, but upon which the salt water is gradually but surely encroaching. In all its varied stages we thus perceive the effects of this depression. The salt water gradually moistening the soil around the roots of the trees, they speedily sicken and die, and before the depression has sufficiently advanced to allow the tides to cover the surface and develop a complete saline vegetation, most of the trees have fallen and decayed, a few isolated stumps of live oaks alone remaining to mark the presence of the ancient forest. Dr. Ravenel had the kindness to show me some points on his plantation where this fact is exhibited in the highest degree of perfection.

To what then can this submersion be due? Mr. Tuomey in his "Geological Report on South Carolina" explains it as resulting from land-slides. He regarded it as produced by the washing away of underlying quick-sands, numerous local instances of which are indeed presented. Thus at Cainhoy, the famous post-pliocene locality on Wandoh river, we observe such slides, where the water has gradually undermined the sand banks. The trees in consequence, assume vertical or slanting positions, in accordance with the circumstance of the action of the water and the extent to which their roots afford them support. But I am induced to believe that such action must be purely local. The far more conspicuous phenomenon to which I refer, can scarcely be satisfactorily explained in a like manner. The single slides rarely extend inland beyond twenty-five feet, while the submersion referred to, is often clearly observable for a distance of at least a mile. Moreover the slides or land-slips are sudden and accompanied by true faults, which are in no instance observable in the other case, nor could the washing away take place except with abrupt banks.

A better explanation, it seems to me, might be sought in a gradual compression (a *settling*) of the deposit *d*, though even that appears to me too local, apart from the fact, that such settling is not likely to exist with a bed, which is constantly exposed to the same, or even to an increased quantity of moisture, and which has already for such an unknown time enjoyed all the facilities for compression, without any present increase of weight above it, from which we might deduce an accelerated action of the kind. To me a positive submersion of the coast,

dependent upon far more vital changes of the crust of our globe, —such as have already been observed in other regions of the world—appears to offer a much more satisfactory explanation. No other suggestion it seems to me can explain the growing inroads of salt water; where neither steep bluff-banks, underlying sand beds or alluvial deposits exist. In addition to this we have already in an earlier part of this communication believed ourselves enabled to detect ancient effects of a similar kind and in so far, at all events, we are supported by analogy when we assert, that a sure and positive though very gradual submersion of our coast is now in progress, at a future day perhaps to be replaced by a gradual elevation.

Another change in the contour of our coast is observable, though confined in its effects. I allude to the gradual southward translocation of our sea-board islands. The northern extremities are constantly washing away and the southern beach extending with equal regularity. This is very beautifully marked with some of the Hunting Islands near Beaufort. Thus Col. B. J. Johnson pointed out to me the spot where he had shot his first buck, which is now a hundred yards or more out in the Atlantic. This change is no doubt due to littoral counter-currents in the Gulf Stream.

Camp Geol. Survey, S. C., August 7, 1859.

ART. XXXIX.—*On the Sudden Disappearance of the Ice of our Northern Lakes in the Spring;* by Gen. J. G. TOTTEN, Chief Engineer, U. S.

(Read before the. American Association for the Advancement of Science, held at Springfield, August, 1859.)

SOME forty years ago, being at Plattsburgh, N. Y., on the margin of Lake Champlain, and not far from the widest part of the lake, I had a favorable opportunity for studying the phenomenon of the sudden disappearance of the great body of the ice covering that lake, a body of very many square miles in extent, and not less than one foot in thickness.

This striking phenomenon has often given rise to wild speculation and conjecture in the unscientific world. It was the subject of discussion some years ago in this Association, and it is under the impression, perhaps erroneous, that full information was not then and has not been since presented, that I now venture to produce the following substance of my observations, though made chiefly at that distant day.

At the close of a day in April, I think, the whole surface of Lake Champlain, with the exception of a very few "air holes"

or unfrozen portions of at most a few acres each, and a strip of water next the shores, was one great expanse of ice, of a thickness not less than twelve inches, and apparently, looking merely at the surface, as solid as ever.

During the following night there arose a strong wind from the southward, blowing, therefore, nearly lengthwise of the lake; and when I looked out the following morning not a particle of ice was to be seen, but instead thereof, a lively play of water sparkling with "white caps." There was, as determined by immediate and close examination, absolutely no ice upon the water nor in the water; not a fragment, large or small. Upon the lee shore of a bay close at hand, there was however, a fringe of broken ice that had been washed up by the waves; and in the condition of these few remains of the night's work was to be found, it seemed to me, a satisfactory explanation of a change certainly very surprising from its suddenness and completeness, and deemed indeed, even by high authority in philosophy, so much to partake of the marvellous as to require a higher solution than philosophy was able, consistently to supply.

I venture, in offering this mite to the collections of the Association, to give the explanation then suggested by my examinations; because, as intimated before, I am not aware that such particulars as I have to describe, have been connectedly given, although they must have been often exhibited to individual observation, and as often, one would think, have led to a explanation simple, satisfactory and clear within the domain of the consistent philosophy that nature loves.

The fringe of broken ice was found to consist wholly of prismatic fragments, all of which, excepting a few broken transversely, were of uniform length, namely a length exactly equal to the thickness of the mass of ice of which they had been portions.*

The sides of these fragments were irregular as to number and form; the breadth or thickness varying sometimes in the same prism from three-quarters of an inch to an inch and a half—perhaps a little more or less; but notwithstanding such variations, there was a general agreement as to shape and size, and the general result in all was a decidedly prismatic form. There were,

* The following description and remarks, as far as relates to details, belongs to the particular case then—so much to my astonishment and surprise, presented to notice. I have observed since, that the circumstances under which bodies of fresh-water ice are formed, are not always favorable to so clear an exhibition of the law of structure. The vertical arrangement of elongated solid pieces, although sometimes quite irregular as to shape and dimensions, and interrupted, lapping in their length, is however, I believe, always to be seen in blocks of ice in which solution is somewhat advanced, and to be detected by cleavage, unless indeed, the process of congealation has been disturbed by forces too great for an observance of the law of crystallization. Such deviations do not however, it is thought, touch the general conclusions to which our case seems to lead us.

over, sometimes to be seen upon their irregular sides, por- of some length that were probably true crystalline faces. epting a small portion at one end of each that was evidently e up of half-melted and refrozen snow, they were very trans- nt, with few air bubbles, and as sonorous, nearly, as similar ns of glass.

xaminations then and afterwards of floating fresh-water ice, ch alone I have observed,) have shown that the natural t of the advancing year is gradually to transform ice, solid apparently homogeneous, into an aggregation of these irreg- prismatic crystals, standing in vertical juxtaposition, having surfaces of contact, but touching rather at points and on s, and kept in place at last, merely by want of room to fall der. Until this change has somewhat advanced, the cohe- strength of ice of considerable thickness is still adequate to in the weight and shock of the travel it had borne during winter, but becoming less and less coherent, by the growing tion of the prisms, or more and more "rotten," as the phrase ough retaining nearly all its thickness, the ice will at last ely support a small weight, though bearing upon a large ce—the foot of man easily breaking through, and very slight tance being made to the point of a cane.

efore describing the peculiar preliminary process by which brought to this condition, it may be well to follow out the by which the striking phenomenon of the sudden disap- ance, by melting, of vast fields of thick ice is accomplished. final forces of dissolution will vary somewhat with circum- es, but in all cases where the ice has been, so to speak, duly ared, nothing is wanting to a quick disappearance, but a dis- ion of the few remaining surfaces of contact in the prismatic nblage. If this be not abruptly effected by undulations in the of ice, solution will continue to erode the sides of the con- ent prisms, until, being no longer in contact, or adequately ined laterally, each will drop into the position in the water w, required by the place of its own centre of gravity—that say, it will lie upon its side, exposing large surfaces to the n of the warm water. It is easy to see that this will occur, t simultaneously, with all the prisms, in rapid succession.

ıt the effects, in the instance that first drew my attention, the results of violence, causing the greater surprise by sud- y bringing about what, according to the calm process above ated, would have been postponed for many days.

ie condition of the ice on Lake Champlain on the day in 1 before mentioned, being a mere aggregation of vertical natic crystals, cohering only at points and along edges and w surfaces, as shown next morning by fragments on the , it could oppose little resistance to waves raised by the wind

of the following night. These acting first upon the edges of the air-holes and open spaces between the ice and the shore, caused slight undulations then in the ice itself, and the consequent pulling apart of the feebly cohering prisms, so that, the water surfaces being thereby enlarged, a short time only was necessary for the waves, increasing in altitude and force with the enlarging water surfaces, to send their undulations far before them under the yielding ice. The prisms falling upon their sides, all more or less immersed, affording now large surfaces to the solvent action of water above the melting temperature, and stirred about by the waves, were quickly dissolved. It is not easy to say in how short a time, under such circumstances, the great transformation would be wrought, but there ought to be no surprise that all was accomplished in the eight or ten hours of a spring night.

The preliminary process, before alluded to, of the conversion of masses of solid ice into an aggregation of vertical prisms by partial solution must be dependent on the fact that the law of crystallization in that substance yields prisms with vertical axes. That this is the law is indicated by cleavage as well as by solution; for while this is easy and free in planes perpendicular to the upper surface, it is said, truly I believe, not to be attainable in directions oblique or parallel thereto. Beyond this general fact of a vertical arrangement of prisms it is not necessary to go for elucidation of our subject, even if I could give minute specifications as to the crystallization of ice. I am not aware, indeed, that this question in crystallography, interesting as it might prove, has been very thoroughly investigated; but however that may be, we have demonstrated to us by the natural process of solution, that ice formed as in the case before us, however solid and homogeneous in appearance, contains a hidden array of crystalline prisms. So much is certain; and this, for the present, is enough on that point. May we not farther assume, that in the process of arrangement about the axes of these prisms, as they are projected downwards into the freezing water, the particles of water, in obeying the law of crystallization, crowd out, radially, the portions of air that would otherwise interfere with their just disposition as ice; and that, at last, this air, by accumulation in spaces between the prisms, suffices to prevent further obedience to the symmetrical principle, causing in these spaces, a confused and porous crystallization peculiarly favorable to the action of a solvent? Whether this be the precise cause or not, a condition favorable to dissolution certainly exists in the irregular spaces between the prisms, as we see by the particulars before given.

The process of Daniel for bringing to view the innate crystallization of apparently amorphous masses—namely, submitting

them to the action of a solution of the same substance, so nearly saturated as to exercise solvent power only when the solidification is imperfect—seems to afford a close analogy to that followed by nature, in preparing ice for quick dissolution.

The natural action seems to be this. The early rains of spring throw upon the surface, and by the tributaries, pour under the fields of ice frequent supplies of water, at a temperature melting even at first, and rising with the progress of the year. This warm underlying water, acting chiefly on the porous spaces between the prisms, dissolves them out to the full depth to which the ice is immersed, and perhaps still farther, by capillary action. At the same time, the spongy ice, formed upon the upper surface by melted and refrozen snow, affords warm water, by melting and percolation, to affect similarly the porous spaces between the tops of the prisms.

In this way, during the considerable period intervening between the first spring rains and the final breaking up of the lake, the solid ice is transformed into the condition necessary to a sudden dissolution.

We may assume, indeed, that the solvent action begins on the lower surface, about the time the accretion, by farther freezing, ceases; that it proceeds very slowly, so long as the temperature of the water remains below that of the greatest density, and of course that it goes on more rapidly as the water is lifted above that temperature by the growing warmth of spring.

I regret that I did not take the temperature of the water in the morning after the disappearance of the ice; but on this point I may add to what is said above, that the spring was then well forward, all, or nearly all, the snow had melted from the fields; the early rains and melted snows had for some time been raising the lake, which was then nearly at its greatest height. It was this rise in the lake that had spread a margin of water *that did not freeze* between the great field of ice and the shore. The inference from all the circumstances, that the temperature of the water at the time of disruption, and for some time previous, was not only above the melting point, but also above that of maximum density, seems to me unavoidable.

I may here be permitted to mention another matter connected with fields of lake-ice that has excited some wonder, namely, the movement towards the shore of boulders, sometimes quite large. The process which must have occurred to intelligent observers, and has probably been heretofore explained, seems to be this: after the rising of the water has supplied an unfrozen margin, a strong wind will sometimes cause the whole field to move until its edge meets adequate resistance upon the shore, all boulders encountered in the way, being pushed before it, into an array upon the shore that accurately marks the extent of the

invasion. These lines of boulders are to be seen in many places, registering accurately, not the work of the preceding year, but the greatest effort of any previous year.

The circumstances of some deep-lying boulders may be such that they are rarely embraced, acted on, or moved, and such may long, by fits, continue to be erratic, though finally to join the general shore parade.

The force of these moving fields is very great, even when the decomposing process is much advanced. I have seen a timber wharf, which was about thirty feet square, ten or fourteen feet high, and filled solidly with earth and stones, shoved along the bottom about thirty feet, by a single continuous push of a great field of ice just ready to be resolved into its prismatic elements. The motion was very slow, only to be seen, indeed, by close observation, while the ice was broken at the edge of contact into innumerable fragments, piling themselves, with a tinkling sound, high upon the wharf and following ice.

A simple and effectual guard against this danger to wharf or pier has been found to be, the giving to the exposed face a certain talus (about one of base to two of height, I think), which turns the ice upwards to the top of the structure, where its fragments accumulate, sometimes to a considerable height. This easy diversion of so great a force is due, of course, to the peculiar crystalline structure of the ice, the degree to which it has been decomposed, and the consequent brittleness against a transverse strain. Should there be an unfrozen margin to permit this motion of large fields of ice, before the solution of continuity in the crystalline arrangement, nothing but the solid earth could stand before it.

These remarks have extended further than I intended, and I fear much beyond what was required by the state of knowledge on the subject. But I venture, nevertheless, in reference to the first portion of these remarks, one further observation—namely, that nature seems to have especially provided, in the structure of these wintry coverings of water surfaces, for their prompt removal, when their existence would retard the advancing year.

ART. XL.—*On some Reactions of the Salts of Lime and Magnesia, and on the Formation of Gypsums and Magnesian Rocks;* by T. STERRY HUNT, F.R.S., of the Geol. Survey of Canada. (Continued from this vol., p. 187.)

IV.

Facts in the history of Gypsums, Dolomites, Magnesites and Limestones.

43. The gypsums found in nature may be divided into two classes, those directly deposited from water, and those produced by the alteration of beds of limestone. To the latter division belong the gypsums found in the vicinity of solfataras, where, as Dumas has shown, the slow oxydation of moist sulphuretted hydrogen gives rise to sulphuric acid, which transforms beds of carbonate into hydrated sulphate of lime. We must equally refer to the same class those gypsums which are formed among calcareous rocks by the action of waters containing free sulphuric acid. Such a process I have long since described in Western Canada, where numerous springs containing besides sulphates of lime, magnesia, oxyd of iron, alumina, and sulphuretted hydrogen, three or four thousandths of free sulphuric acid, rise through Upper Silurian strata, in the calcareous portions of which they sometimes give rise to masses of gypsum.

Bischof (*Chem. Geology*, i, 418), who does not appear to have seen my analyses of these acid waters, rejects my view of the epigenic origin of these masses of gypsum, although it will be apparent to every one who examines the facts, that the action of such waters upon calcareous strata must give rise to sulphate of lime. I do not however confound these recently formed masses of sulphate of lime with the older gypsums, which associated with dolomites, sea-salt and sulphur, are abundant in the Saliferous or Onondaga salt group of the same region.—(*Am. Jour. Sci.*, [2], vii, 175; *Report Geol. Survey*, 1848, 150; *Comptes Rendus de l'Acad.*, 1855, xl, 1348.)

These acid waters which make their appearance in an almost undisturbed region, I conceive to have their origin in deeply buried strata, where gypsum or other sulphates may be undergoing decomposition by the action of water and silica at an elevated temperature, a process analogous to that which gives rise to exhalations of carbonic acid gas.

44. Waters containing free sulphuric acid or ferric or aluminous sulphate, may by flowing into basins where carbonate of lime is present, give rise to solutions of sulphate of lime, and the evaporation of these, of sea-water or other gypseous solutions must give rise to deposits of sulphate of lime, which will

belong to the first division mentioned above. These modes of formation however do not account for an important fact in the history of most stratified gypsums, which is that of their almost constant association with carbonate of magnesia generally in the form of magnesian limestone. Beds of dolomite are often interstratified with or include beds or masses of gypsum, while dolomite and carbonate of magnesia are sometimes found imbedded in gypsum or anhydrite. For a description of the magnesite which is disseminated in the gypsum of Salzburg, see Dufrénoy, *Minéralogie*, 2d ed., ii, 424. Small masses of compact and crystalline gypsum, occasionally associated with crystals of calcite and quartz, abound in some of the dolomite beds of the so-called Calciferous sandrock in Canada, and crystallized gypsum and anhydrite, together with sulphates of baryta and strontia, and fluor spar, occur in geodes in the magnesian limestone of Niagara. The anhydrous sulphate of lime not only forms beds by itself but is often met with disseminated in masses, grains or crystals through beds of gypsum, and even interstratified with it, as in the south of France, in the Hartz, Switzerland, and in Nova Scotia, as described by Mr. Dawson. (*Acadian Geology*, 225.) The conversion of beds of anhydrite into gypsum by the absorption of water, and the attendant phenomena, have been described by Charpentier.

45. Both the hydrous and anhydrous sulphate sometimes form the cement of conglomerates or breccias, which enclose flints, fragments of shale and of limestone, as at Pomarance in Tuscany, (Scarabelli, *Bull. Soc. Géol. de France*, [2], xi, 346,) and also at Bex, where the cement of the conglomerate is a granular anhydrite (Charpentier, *Ibid.*, [2], xii, 546).

Gypsums moreover often include clay and sand, and sometimes contain a considerable admixture of carbonate of lime, which in those of Aix, according to Coquand, amounts to eight per cent. The gypsums of Montmartre also contain, according to Delesse, besides some clay and sand, and several hundredths of carbonate of lime, not less than three per cent of soluble silica intermixed. Silica in the form of flint or chert is sometimes found in concretions with gypsum; thus in the miocene clays near Bologna in Italy, flints are met with associated with sulphates of lime, of baryta and strontia, together with pyrites and sulphur. Masses of sulphate of strontia are likewise found in clays with the gypsums of Montmartre, and the association of sulphate of strontia with the sulphur, gypsum and rock salt of Sicily is well known. The gypsums of Madrid, which occur in tertiary clays, are according to Casiano de Prado, accompanied by beds of chert and of magnesite (*Bull. Soc. Géol. de France*, [2], xi, 334).

Besides the rock salt which so often occurs with gypsum, we may here recall its frequent association with the sulphates of soda and magnesia, both of which are found in very many places imbedded in gypsum, or intermingled with rock-salt or with the associated clays. (Bischof, *Chem. Geology*, ii, 421–431.) Large deposits of both of these sulphates occur with gypsum and rock-salt in Spain; in Nova Scotia also sulphate of soda is found in gypsum with boro-calcite, an association worthy of notice from the occurrence of boracite, both crystallized and massive (stassfurthite) with gypsums in Germany.—(How, *Am. Jour. of Science*, [2], xxiv, 230.)

46. The gypsums of the class which we are now describing appear in every geological period. To these apparently belong the masses of gypsum and anhydrite, which at Fahlun are associated with dolomite and serpentine in the chloritic bands of the oldest crystalline rocks of Scandinavia, the probable equivalents of the Laurentian system of North America. On this continent the oldest known gypsums are those already mentioned as occurring near the base of the palæozoic series, and in what is called by the geologists of New York the Calciferous sandrock. As we ascend the series gypsum is occasionally met with in the Clinton and Niagara groups, until we reach the Onondaga salt-group in the Upper Silurian rocks of Canada and New York, which contains great deposits of dolomite and gypsum, occasionally accompanied by sulphur. The gypsums, anhydrites, and brine springs of Nova Scotia belong to the Carboniferous series, while the frequent recurrence of gypsum in Europe through all the higher rocks up to the Miocene inclusive, is too well known to require notice.

47. The so-called primitive gypsums and anhydrites, which in the Alps and Pyrennees occur interstratified with crystalline schists, are now known to belong to altered secondary strata. These gypsums enclose many crystalline minerals, such as talc, mica, epidote, hornblende, dipyre, beryl, quartz, hematite, blende and pyrites. At Saurat in the Pyrennees many of these minerals appear in the vicinity of a mass of granite which penetrates and alters both fossiliferous limestone and gypsum. The latter becomes mingled with and finally passes into limestone. (Coquand, *Bull. Soc. Géol. de France*, [1], xii, 345.) In Algiers, where gypsum is associated with crystalline limestone, gneiss, amphibolite and serpentine, small crystals of beryl are found disseminated alike through the limestone and the gypsum. Some of the gypsums of the Hartz, according to Frapolli, contain nodules of a silicate of magnesia colored by carbonaceous matter, and having the softness and the chemical composition of steatite.—(*Ibid.*, [2], iv, 832.)

48. The marine origin of the greater number of gypsiferous formations is evident both from the accompanying rock salt and the associated fossils, but certain gypsums (as well as certain dolomites,) have evidently been deposited in fresh-water basins. A gypsum from Asia Minor examined by Ehrenberg contains a great number of fresh-water polygastric infusoria, and beds of gypsum occur in the lacustrine basins of Aix and of Auvergne; the gypsiferous strata of the Paris basin are also regarded as of fresh-water origin.

49. Besides the magnesian limestones of gypsiferous strata great deposits of dolomite occur in the rocks of every geological period. I have long since described the dolomites which form extensive beds, often associated with ophiolites and with crystalline limestones, in the Laurentian system in Canada. Great portions of the palæozoic limestones of North America are magnesian, especially in the valley of the Mississippi,* while deposits of dolomites are found in Europe alike in the Permian, Triassic, Jurassic, and Tertiary strata. Mr. Dana has even described as of recent formation a dolomite from the coral island of Matea, examined by Silliman and myself.—(*Am. Journal of Science*, [2], xix, 429.)

50. The mechanical conditions of these magnesian limestones vary greatly; they are sometimes made up of crystalline grains of dolomite, which are strongly coherent, or more rarely form a loose sand. Not unfrequently the magnesian limestones are concretionary in their structure, and may be oolitic or botryoidal. The action of the concreting force has sometimes obliterated the marks of stratification. The porous or cavernous structure of many dolomites is also to be remarked.

* For the following facts with regard to the dolomites of the palæozoic rocks of the Mississippi valley, I am indebted to Prof. James Hall of Albany. We have there in ascending order:

1st. The so-called *Lower Magnesian limestone*, which is regarded as the equivalent of the Calciferous Sandrock, and is from 200 to 250 feet in thickness. It is the lead-bearing rock of Missouri, and probably contains the cobalt ores of that region.

2d. The *Galena limestone*, consisting of about 250 feet of dolomite interposed between the Trenton and the Hudson River groups. It is the lead-bearing rock of Iowa, Wisconsin and Illinois.

3d. The *Niagara limestone*, also dolomitic, about 250 feet in thickness, and sometimes holding galena and blende.

4th. The *Leclaire* or *Galt limestone*, a dolomitic formation interposed between the last and the Onondaga Salt Group. It attains upon the Mississippi a thickness of 500 feet, but thins out to the eastward.

5th. The magnesian limestones of the *Onondaga salt group*, 100 feet thick.

6th. A dolomitic deposit in the upper part of the Carboniferous series.

The formation No. 1, although generally regarded as the equivalent of the Calciferous sandrock, is perhaps the representative of the Chazy limestone, which on Lake Huron is sometimes a pure dolomite, and on the island of Montreal includes thin magnesian beds. The Calciferous sandrock itself, throughout Lower Canada, includes extensive beds of dolomite, and the Hudson River group is characterized by beds of dolomite and of magnesite.

Magnesian limestones often contain large admixtures of clay and sand; dolomite is not unfrequently the cement of breccias or conglomerates, as in the well-known conglomerate of the Permian system in England. Concretionary masses of dolomite sometimes occur in these aggregates, and in the Permian rocks of the Vosges are found in beds of a sandy clay, itself occasionally cemented by dolomite.

I have elsewhere described two remarkable dolomitic conglomerates from the palæozoic rocks of Canada. The first of these belongs to the upper portion of the Hudson River group, and is conspicuously seen at Pointe Levis and on the island of Orleans. The associated rocks are there graptolitic shales, sandstones and fossiliferous limestones, together with great masses of a greenish or grayish-white subtranslucent compact concretionary limestone. This is without distinct marks of stratification, exhibits no trace of organic remains under the microscope, and has all the characters of a travertine or calcareous sinter. Interstratified with this last are beds of bituminous yellow-weathering dolomite, containing carbonate of iron, and always intermixed with more or less sand or clay or both; the clay in one specimen amounted to fifty per cent, while another quartzose variety gave carbonate of lime 53·04, carbonate of magnesia 31·96, carbonate of iron 5·80, silicious sand 8·80=99·60. The latter is a friable crystalline rock, showing in its fracture broad surfaces of cleavage, like the crystals of Fontainebleau sandstone. These dolomites, which contain no fossils, are occasionally traversed by veins of quartz and calcareous spar, or contain small masses of the latter mineral, apparently filling cavities. They are interstratified alike with the travertines and with the fossiliferous limestones, sometimes in large beds, and at other times in lenticular masses or in layers of a few lines in thickness separating masses of the travertine.

The conglomerates of this series inclose in a paste of ferriferous dolomite, grains and rounded fragments of limestone, often having the characters of the associated travertine, together with fragments of quartz and argillite, and small masses of a nearly pure yellowish crystalline dolomite; these are perhaps concretionary in their origin and not imbedded fragments. Other beds of a similar conglomerate occur in the same series having a cement of pure carbonate of lime, and the travertine itself often incloses grains of sand.—(*Geol. Surv. Canada; Report*, 1853–56, p. 465.)

The other conglomerate to be noticed occurs on the islands of Montreal, St. Helens, and several other localities in the neighborhood, and belongs to small detached patches of the Lower Helderberg series, left after denudation, which repose unconformably alike on Lower Silurian and Laurentian rocks. In

some localities they enclose the peculiar feldspars of the latter, in others the fossiliferous limestones, shales, sandstones and cherts of the former series, while in others still the principal elements are black augite, mica and olivine, derived from the igneous rocks which in this vicinity have broken through the Lower Silurian series. These conglomerates, which are remarkable for their great coherence, have a greenish, bluish or grayish yellow-weathering base, and contain much carbonate of iron. The soluble portion of a specimen from St. Helens was equal to 46·0 per cent, and consisted of carbonate of lime 57·8, carbonate of magnesia 16·4, carbonate of iron 25·8=100·0. In one instance these yellow-weathering beds of conglomerate are associated with others of which the cement remains white on the exposed surfaces, effervesces freely with acids, and is pure carbonate of lime. —(*Ibid.*, 1857, 201.)

51. Dolomite also occurs filling up fissures and cavities in other rocks, as in the case of pearl-spar in geodes and veins. The black and yellow marble from northern Italy, known under the name of Portor, and belonging according to Savi, to the Neocomian formation, is composed, by my analysis, of a black, nearly pure limestone containing only one-hundredth of carbonate of magnesia, penetrated by veins of ferriferous dolomite, which gave me 35·5 p. c. of carbonate of magnesia, and 4·6 of insoluble silicious matter, the residue being carbonate of lime and a little carbonate of iron. The veins of magnesian carbonate sometimes give to the Portor the aspect of a breccia.

52. Examples of the apparent infiltration of dolomite occur in black bituminous limestones at Montreal and Ottawa belonging both to the Trenton and Chazy divisions. These limestones, which contain only traces of magnesia, enclose casts of the interior of *Orthoceras, Murchisonia* and *Pleurotomaria*, consisting of a gray crystalline dolomite, weathering reddish, and appearing in high relief upon exposed surfaces of the limestone. In both localities the limestones are traversed by thin irregular veins of a similar dolomite, which communicate with the casts. By the action of dilute hydrochloric acid the limestone matrix is dissolved, and it is seen that the cavity of the fossil is in many cases only partially occupied by dolomite; that portion which is uppermost in the stratum being often filled with carbonate of lime to the extent of one-third or one-fourth, but in other specimens the whole cast is of dolomite. In some of the larger casts there are drusy cavities lined with crystallized dolomite and occasionally containing prisms of quartz. The analysis of a fragment of the cast of an *Orthoceras* from the Trenton limestone at Ottawa, gave me carbonate of lime 56·00, carbonate of magnesia 37·80, carbonate of iron 5·95=99·75. The surrounding limestone, which was compact, bluish-gray, and bituminous, con-

ined 3·9 p. c. of clay and sand; its solution gave 0·6 p. c. of xyd of iron with alumina, but no magnesia. Similar examples ' fossils replaced by dolomite occur in gray limestones associad with the travertines and dolomites of Pointe Levis (§ 50).

53. Magnesian limestones are very frequently destitute of ormic remains; in some cases however they may contain calcaous fossils, as in the Niagara limestone at Dudswell, where rals of the genera *Cyathophyllum*, *Porites* and *Favosites*, comsed of pure carbonate of lime, and generally bluish-black in lor, are imbedded in a yellow ferriferous magnesian limestone hich contains an excess of carbonate of lime. This limestone ive by analysis carbonate of lime 56·60, carbonate of magnea 11·76, carbonate of iron 8·23, insoluble quartz sand 26·72= 3·31. The portion soluble in cold dilute acetic acid was carnate of lime with four per cent of carbonate of magnesia and trace of iron, and the residue when digested with dilute hydroloric acid left 52·0 p. c. of sand and pyrites; the dissolved art consisting of carbonate of lime 51·75, carbonate of magnea 35·73, carbonate of iron 12·52=100·00.

In the magnesian limestone of Galt in western Canada, which a pure crystalline dolomite, there are numerous casts of bilve molluscs, the shells of which were evidently removed by lution after they had been filled and enveloped by the doloitic matrix, since the walls of the cavities once occupied by e shells of a large bivalve, *Megalomus Canadensis*, retain the arkings of the inner and outer surfaces of the shell. Similar oulds of *Ophileta compacta* are abundant in the blue dolomite ' Beauharnois, which belongs to the Calciferous sandrock; in dolomite of the same geological formation from the Mingan lands, the shells of *Ophileta*, *Maclurea* and *Scaphites* are reaced by silica.

In some portions of the Galt formation fragments of encrinal lumns are found replaced by dolomite, which is only distinished by a little difference of color from the matrix. It would pear in this case as if the calcareous fossil having been first moved by solution (§ 30) the cavity had been subsequently lled with dolomite as in the casts found in the Ottawa and [ontreal limestones (§ 52).

54. Although dolomites not unfrequently form by themselves asses of great thickness, as in the Jurassic formation of the yrol and the palæozoic rocks of the west, they are often interratified in an intimate manner with pure limestones. Such is e case with the ferriferous dolomites already noticed in describg the dolomitic conglomerates and travertines of Pointe Levis ; 50). In the Chazy limestone of Montreal, thin irregular layers ' reddish ferriferous dolomite, themselves filled with encrinal lumns, are interposed between beds of fossiliferous limestone.

The magnesian layers being pulverulent, the encrinal columns, which are pure carbonate of lime, are easily separated from their matrix, which gave me carbonate of lime 40·95, carbonate of magnesia 24·19, carbonate of iron 27·03, silicious sand without alumina 9·01=101·18; the iron was in part as peroxyd. The bluish crystalline limestone distant an inch from the magnesian layer gave 18·4 p. c. of white insoluble residue and 1·09 p. c. of carbonate of magnesia.

In these strata we sometimes meet with similar reddish pulverulent layers which contain no carbonate of magnesia, but are composed of carbonate of lime with a large amount of peroxyd of iron; such a mixture in one instance forms the cement of a breccia of fragments of the blue limestone; it was perhaps at one time a double carbonate of lime and iron.

The thin beds of dolomite above described are closely associated with those holding the dolomitic casts of orthoceratites already noticed; these were enclosed in a nearly black compact limestone, which during its solution in hydrochloric acid evolved traces of sulphuretted hydrogen. The residue contained a little iron pyrites which was removed by nitric acid; it was black from carbonaceous matter, but became white by ignition in the air, and was an impalpable powder, equal to 12·8 p. c. of the rock. Dilute soda ley removed from it 9·5 p. c. of its weight of soluble silica, and the residue had nearly the composition of a feldspar. It gave me, silica 73·02, alumina 18·31, lime 0·93, magnesia 0·87, potash 5·55, soda 0·89=99·57.

The fossiliferous yellow magnesian limestones of Dudswell (§ 53) are in like manner interstratified with beds of gray crystalline limestone containing 6·3 p. c. of sand and only 1·3 p. c. of carbonate of magnesia. These beds having been much disturbed and broken, the interstices appear to have been filled up with portions of the yellow magnesian paste giving rise to a marble which in some portions resembles the so-called Portor, (§ 51).

55. We see from the above examples that dolomites may occur interstratified both with limestones of organic origin and with others which are evidently chemical deposits. Allied to these latter are certain porous tufaceous beds of carbonate of lime which sometimes accompany dolomite. Such tufas occur alternating with the dolomites and gypsiferous marls of the Onondaga salt group. A similar layer of cellular calcareous tufa, free from magnesia, I have observed immediately covering a deposit of crystalline incoherent dolomite in the Eocene series at Pont St. Maxence in France.—(See also Damour, *Bull. Soc. Géol. de France*, [2], xiii, 67.)

56. The chemical constitution of the rocks containing carbonate of magnesia now demands our consideration. Pure dolomite

is well known to consist of equivalents of carbonate of lime and magnesia corresponding to 45·65 parts of the one to 54·35 of the other, and many magnesian limestones have this composition, or contain beside only mechanical impurities, such as sand and clay. Others with an excess of carbonate of lime are shown by the method of Karsten to be mixtures of dolomite with carbonate of lime, which is readily separated by the solvent action of cold dilute acetic acid (§ 28, § 53). The same chemist however found in clefts and fissures of the gypsiferous rocks of Luneberg and elsewhere, carbonates of lime and magnesia mingled with clay, from which dilute acetic or muriatic acid removed the whole of the lime, leaving a residue of from 4·0 to 68·0 p. c. of magnesian carbonate which had evidently been mechanically intermingled with the carbonate of lime. (Bischof, *Lehrbuch*, ii, 1161.) Since the presence of sulphate of lime appears to prevent in a great measure the union of the two carbonates (§ 31), we might suppose that the association of gypsum with these magnesian clays had in some way hindered the formation of the double carbonate. The free carbonate of lime which they contain is however probably epigenic and produced by the decomposition of a portion of the magnesite by the infiltration of dissolved gypsum.

Carbonate of iron often replaces a part of the magnesian carbonate in dolomites, which also sometimes contain carbonate of manganese, and even carbonates of zinc, cobalt and lead. It not unfrequently happens that the sum of the other carbonates in these ferruginous dolomites is more than equivalent to the carbonate of lime. Such is the case with the dolomitic conglomerate of St. Helens (§ 50).

The dolomites of the Hudson River group in eastern Canada are very often associated with copper, nickel, titanium, chrome and manganese. A grayish granular dolomite from Sutton, which contains disseminated chlorite and crystals of magnetite, weathers blackish-brown from the presence of manganese. The foreign minerals are arranged in bands, and layers of the dolomite an inch or two in thickness are apparently free from admixture. The analysis of such a portion gave me, carbonate of lime 40·10, carbonate of magnesia 20·20, carbonate of iron 10·65, carbonate of manganese 7·65, insoluble, chiefly quartz, 21·45= 100·00. The associated crystals of magnetite contained no trace of manganese.*

* Carbonate of manganese is frequently met with in the rocks of this geological series, causing them to weather brownish-black. I have described an impure chloritic limestone of this kind from Granby (Canada East), which contains besides protoxyds of manganese and iron, portions of chrome, nickel and titanium. (Report, 1853-56, 474, and this Journal, [2], xxvi, 238.) Rogers has in like manner noticed the occurrence of a large proportion of protoxyd of manganese in the olive colored slates of the Lower Silurian series in Pennsylvania, and to the decomposition of

57. Magnesian limestones containing an excess of carbonate of magnesia are not uncommon; one from the muschelkalk of Thuringia gave to Senft, carbonate of lime 42·9, carbonate of magnesia 55·4, besides 2·7 of carbonate of iron =101·0. A lacustrine dolomite from the brown-coal formation near Giessen contains, according to Knapp, carbonate of lime 42·80, carbonate of magnesia 49·63, besides oxyd of iron and impurities, and a specimen from the Lower Magnesian limestone from Lake Superior gave to Whitney, carbonate of lime 25·28, and carbonate of magnesia 32·57, besides 37·0 of sand and a little iron and alumina.

Similar magnesian rocks are described by Alberti as occurring in the variegated marls of the *keuper* or upper part of the Triassic system in Germany. A tender greenish schistose marl from Tubingen effervesced very slightly with acids, and gave for 100·00 parts, carbonate of lime 14·56, carbonate of magnesia 19·10, the remainder being clay with a little iron-oxyd. (Senft, *Die Felsarten*, 134.) Von Bibra has described similar magnesian marls from the muschelkalk in Franconia (Bischof, *Lehrbuch*, ii, 1158), and Gueymard from the gypsums of Roquevaire in Provence. The bituminous salt-clays (*salzthon*) which occur with gypsum and rock salt, when freed by washing from soluble salts, contain according to Schafhautl, carbonates of magnesia and iron often with very little carbonate of lime, the argillaceous matter varying from 12·0 to 70·0 p. c. (Bischof, *Lehrbuch*, ii, 1725.) To these clays are perhaps related the magnesian marls examined by Karsten (§ 56). Völckel has described a dark gray rock interstratified with limestone from the *keuper* near Solothurn, and consisting of carbonate of magnesia 54·55, carbonate of iron 33·94, carbonate of lime 0·67, with 10·81 of clay, water, etc. (*L. and K. Jahresbericht*, 1849, 581.)

58. Magnesian rocks allied to the last occur in the Hudson River group of eastern Canada, and were described by me several years since. In the township of Sutton, interstratified with dolomite, steatite and talco-quartzose strata, is a bed of green and white reddish-weathering crystalline rock, gneissoid in structure, and containing variable porportions of magnesian carbon-

such rocks correctly ascribes the origin of the deposits of peroxyd of manganese met with in that region. Beds of silicate of manganese, more or less intermingled with carbonates of manganese and lime, are interstratified with crystalline schists in various localities in New England. I may mention in this connection a compact massive carbonate of manganese which is said to occur in slates supposed to be of Silurian age, at Placentia Bay, Newfoundland, and which I received from Dr. J. W. Dawson. It is conchoidal in fracture, translucent on the edges, with a feeble waxy lustre; color fawn to pale chestnut-brown. H. 4·0. D. 3·25. It is penetrated and incrusted in part with crystalline peroxyd of manganese. Acids in the cold scarcely attack this mineral, but heated nitric acid dissolves it with effervescence, leaving a residue of 14·4 p. c. of silica, of which the greater part is soluble in a dilute alkaline solution. The analysis gave me besides 84·6 p. c. of carbonate of manganese, and traces of lime, iron and magnesia. (Report, 1857, 204.)

ate. A pure and nearly white fragment gave to hydrochloric acid, carbonate of magnesia 83·35, carbonate of iron 9·02, and left insoluble 8·03=100·40; while another specimen from the same mass contained, carbonate of magnesia 33·00, carbonate of iron 19·35, alumina 0·50, insoluble 45·90=98·70. In both cases the solution contained a little nickel, which occurs in the rock, in part at least, in the form of grains of nickeliferous pyrites. The insoluble portion is a silicate of alumina and alkalies, with a little magnesia, and appears to consist of a mixture of feldspar with a little mica and talc, the latter minerals being colored emerald-green by a small portion of oxyd of chrome.

In the township of Bolton there occurs a bed of magnesite many yards in breadth, interstratified between steatite on the one side, and an impure ophiolite passing into diorite, on the other. It is made up of brilliant cleavable grains of magnesian spar, bluish-gray or nearly white in color, and intermingled with others of white hyaline quartz, which sometimes forms small irregular veins. One of several analyses of this rock gave me, carbonate of magnesia 59·13, carbonate of iron 8·32, insoluble 32·20=99·65. In other specimens the proportion of carbonate of iron is a little greater, and traces of carbonate of lime are sometimes met with, while nickel is never wanting and sometimes coats the joints of the rock with a yellowish-green film of what appears to be a hydrocarbonate of nickel; the proportion of this metal determined upon a considerable quantity of the rock was found equal to about one-thousandth. The insoluble residue from this magnesite was greenish-gray in color, and gave by analysis 93·6 p. c. of silica, besides some alumina, 0·8 of alkalies, and traces of lime, magnesia, and oxyd of chrome, which gives an emerald-green color to some portions of the rock. I have already shown that nickel is rarely absent from the magnesian rocks of this region, where it is generally accompanied by chrome. These magnesites in powder do not perceptibly effervesce with cold hydrochloric acid, which however readily dissolves them with the aid of heat. The decomposition of the contained carbonate of iron renders their weathered surfaces reddish-brown and pulverulent.—(*Report*, 1853–56, p. 460.)

I have detected a quartzose magnesite closely resembling that of Bolton, containing nickel, and stained emerald-green by oxyd of chrome, among a collection of rocks brought from California by Mr. W. P. Blake, who also found a bed of nearly pure white compact carbonate of magnesia among the crystalline schists of that region. I may here recall the existence of beds of magnesite among argillites in Styria, and also in the ancient crystalline gneiss of Modum in Norway, where a crystalline magnesite is the gangue of crystals of serpentine and ilmenite.—(*Am. Jour. of Science*, [2], v, 389.)

59. The greater number of dolomites and magnesian rocks are shown by their fossils or by the nature of the associated strata to be of marine origin, but dolomites are also found in fresh-water deposits. Such is that with excess of magnesian carbonate from the brown-coal formation near Giessen (§ 57), and dolomites are said to occur with the lacustrine limestones of Dachingen near Ulm.—(Senft, *Die Felsarten*, 133.)

V.

On the mode of formation of the preceding rocks.

60. Having in the fourth division of this paper brought together the principal facts in the history of magnesian rocks, as well from the researches of others as from our own observations, we have seen that these rocks consist essentially of dolomite, mixed with carbonate of lime on the one hand, and with carbonates of magnesia and iron on the other, passing thus into magnesite. The frequent intermixtures of sand and clay and even of fragments of quartzite, argillite and limestone, clearly show their sedimentary origin, which is moreover rendered evident by the fact that they are often interstratified with pure limestones and even inclose calcareous corals; these facts exclude the idea of the formation of all such dolomites at least, by the alteration of deposits of carbonate of lime as supposed by Von Buch, Haidinger and Favre.

61. The dolomites of the Tyrol which Von Buch imagined to have been formed from the alteration of limestones by magnesian vapors evolved at the time of the ejection of certain melaphyres of that region, have been shown to be much more recent than these melaphyres, which according to Fournet are not intrusive but sedimentary rocks, probably of Carboniferous age, altered *in situ*. These metamorphosed strata are separated from the dolomites, which are Jurassic, by unaltered Triassic strata, including the muschelkalk and a conglomerate holding rolled fragments of the melaphyres.* (*Bull. Soc. Géol. de France*, [2], vi, 506–516.) In several other cases where dolomization was supposed to have been produced by the proximity of igneous rocks, Delesse and Delanoüe have shown that the change had been limited to an alteration in the texture, and that there had been no addition of magnesia.

62. Favre supposes with Haidinger that magnesian solutions under heat and pressure have given rise to dolomites by decomposing beds of limestone with formation of carbonate of magnesia agreeably to the observations of Von Morlot and Marignac. (*Ibid.*, [2], vi, 318.) This hypothesis is evidently not applicable

* Bischof cites *Fournet, Histoire de la Dolomie*, 1847, but I have not been able to consult the work in the preparation of this paper.

those magnesian limestones which include beds, fragments or ganic remains of pure carbonate of lime. In any case we ust suppose a long continued filtration of solutions of magneın chlorid through the heated limestone under certain condiıns which seem at least improbable.

63. The theory of the formation of magnesian sediments will readily understood from the experiments which have been scribed in the earlier parts of this paper, but before proceeding its consideration I wish to call attention to the results of the ncentration by evaporation of natural waters in basins with.t an outlet. If such a basin contain sea-water, the gypsum, ing insoluble in a saturated brine, will be entirely deposited fore the crystallization of the sea-salt, and there will remain iquid containing no lime-salts, but chlorids of sodium and magsium with a large amount of sulphate of magnesia. Such are e waters of Lake Elton and many of the brine pools of the ıssian steppes, while on the contrary the saturated brines of e Dead Sea and some other salt lakes contain little sulphate .t abundance of chlorid of calcium, and if they are the residues sea-water, have been modified by additions of this salt, which s converted the sulphate of magnesia into chlorid of magneım and gypsum, the calcareous chlorid remaining in excess. But while some of these saline lakes may be supposed to be sins of sea-water, modified by evaporation, either alone or con.ned with the influx of foreign saline matters, others were evintly once fresh-water lakes in which, the loss of water being ual to the supply, have gradually accumulated the soluble lts of all the rivers and springs flowing into the lake. We ıy arrive at some notion of the diverse natures of the different line lakes which would be formed in this way if we suppose e waters of different European rivers to be subjected to evapation under conditions like those of the salt lakes of Western sia. In the waters of the Elbe and Thames chlorids greatly edominate (in the latter with gypsum), with small amounts of ıgnesian salts, and the evaporation of these waters would give ıe to lakes containing a large proportion of common salt. In e Seine on the contrary, sulphate of lime predominates, while e waters of the Rhine, the Danube, the Arr and the Arve ntain but small amounts of chlorids and large proportions of lphates of lime and magnesia.

64. In other rivers we find alkaline salts; the Loire at Orleans, cording to Deville, contains in 100,000 parts, 13·46 of solid atters, of which 35·0 p. c. is carbonate of lime, 30·0 p. c. silica, ıile two-thirds of the more soluble salts consist of carbonate soda. In the waters of the Garonne, with as large a proporın of silica, and more carbonate of lime, the carbonate of soda uals one-fourth of the soluble salts, while 100,000 parts of the

water of the Ottawa, according to my analysis, contain 6·11 parts of solid matters, consisting of carbonate of lime 2·48, carbonate of magnesia 0·69, silica 2·06, sulphates and chlorids of potassium and sodium 0·47, and carbonate of soda 0·41. (*Report Geol. Survey of Canada*, 1853–56, 360, and *Philos. Mag.*, [4], xiii, 239.) Silica, although more abundant in alkaline river waters, which are chiefly derived from crystalline rocks, is not wanting in waters containing neutral earthy salts, like the Seine and the Rhone, of the solid matters of which, according to Deville, it forms respectively 10·0 and 13·0 p. c.—(*Ann. de Chem. et Phys.*, [3], xxiii, 82.)

The waters which rise from the Lower Silurian shales of the St. Lawrence valley are, as I have elsewhere shown, remarkable for the predominance of alkaline salts, which sometimes amount to one-thousandth, or more than one-half the solid matters present; these waters are distinguished from the river waters just mentioned by their comparatively small amount of silica and earthy carbonates, and by the presence of a notable proportion of borates.—(*Rep. Geol. Survey of Canada*, 1852, p. 165,—1853–56, p. 469, and *Proc. Royal Soc.*, *Phil. Mag.*, [4], xvi, 376.)

We may here refer to the strongly alkaline waters furnished by the artesian wells of Paris and London as evidences of the abundance of alkaline carbonates in natural waters, and to the springs of Vichy and Carlsbad, the latter of which, according to the calculations of Gilbert, furnish annually more than thirteen millions of pounds of carbonate of soda. The evaporation of these alkaline waters, whether rivers or springs, must give rise to natron lakes like Lake Van and those of the plains of Araxes, Lower Egypt, and Hungary.—(Bischof, *Lehrbuch*, ii, 1143.)

The carbonate of soda contained in these waters has its source in the decomposition of feldspathic minerals, and shows the continance in our time of a process whose great activity in former geologic ages is attested, as I have elsewhere maintained, by vast accumulations of argillaceous sediments deprived of a large portion of their soda, and also by the carbonate of lime which by the intervention of carbonate of soda has been formed from the chlorid of calcium of the primeval ocean and deposited as limestone.

65. An indispensable condition for the precipitation of carbonate of magnesia is the absence of chlorid of calcium from the solutions, and this in the presence of excess of sulphates is attained simply by evaporating to the point where gypsum becomes insoluble. In nearly all river and spring waters bicarbonate of lime is present in a large proportion, and is often the most abundant salt. We have shown that when mingled with a solution containing sulphate of magnesia, it gives rise by double decomposition to bicarbonate of magnesia and sulphate of lime.

By the evaporation of such a solution, the latter salt, being the less soluble, is first deposited in the form of gypsum, while the magnesian carbonate is only separated after farther evaporation, when, provided the supply of bicarbonate of lime still continues, the two carbonates may fall down in a state of intermixture. In this way sediments will be formed containing the elements of dolomite or magnesite.

66. The solution of magnesian carbonate remaining after the deposition of the gypsum, possesses, as we have seen, the power of decomposing chlorid of calcium, and when deprived of a portion of its carbonic acid by evaporation, reacts in a similar manner with a solution of sulphate of lime (§ 5, § 23). In this way, an influx of sea-water into the basin from which gypsum, and perhaps a portion of magnesian carbonate has already been deposited, would give rise to a precipitate of carbonate of lime, like the tufaceous limestones, whose occurrence with gypsum and dolomites has been already noticed. In basins which, like the salt lagoons of Bessarabia on the shores of the Black Sea, receive occasional additions of sea-water, and deposit every summer large amounts of salt, (Bischof, *Lehrbuch*, ii, 1717,) the influx of waters containing bicarbonate of lime would give rise to the formation of beds of gypsum, alternating with dolomites or magnesian marls and rock salt.

67. We have already referred to the analyses of certain rivers, in which the sulphates are more abundant than the chlorids. Thus, in the Rhine, near Bonn, according to Bischof, we have for 100,000 parts of the water, 17·08 of solid matters, of which 1·23 are sulphate of lime, 1·81 sulphate of magnesia, with only 1·45 of chlorid and 8·37 of carbonate of lime; in the Danube near Vienna, the predominance of sulphates is still more marked. The waters of the Arve, in the month of February, gave to Tingry, for 100,000 parts, 24·5 of solid matters, of which 6·5 were sulphate of lime, 6·2 sulphate of magnesia, and 8·3 carbonate of lime, with only 1·5 of chlorids. Now, as in river waters there is always present an excess of carbonic acid, and as bicarbonate of lime and sulphate of magnesia in solution are mutually decomposed, these waters, which are to be regarded as solutions of sulphate of lime and bicarbonate of magnesia, (§ 18) would, by their evaporation, yield gypsum and magnesian carbonate, which would appear as portions of a fresh-water formation, like those of Aix and Auvergne.

The decomposition of soluble sulphates by bicarbonates of baryta and strontia, will explain the formation of heavy spar and celestine, and their frequent association with gypsiferous rocks.

68. As to the native sulphur which is often associated both with epigenic and sedimentary gypsums, it has doubtless in every case been formed as Breislak long since indicated, by the

decomposition of sulphuretted hydrogen. It is well known that alkaline and earthy sulphates are reduced to sulphurets by organic matters, with the aid of heat, or even at ordinary temperatures, in presence of water. To the decomposition of these sulphurets by water and carbonic acid, we are to ascribe not only the sulphuretted hydrogen of solfataras, which, by its oxydation under different conditions, gives rise either to free sulphur, or to sulphuric acid and to gypsum by epigenesis, but also the sulphuretted hydrogen which appears in springs and in stagnant waters, where the sulphur produced by the decomposition of the gas is often mingled with sedimentary gypsums.* (See Bischof, *Lehrbuch*, ii, 139–185.) This author has suggested the decomposition of chlorid of magnesium by alkaline or earthy sulphurets as a source of sulphuretted hydrogen and hydrate of magnesia, into which sulphuret of magnesium is readily resolved in the presence of water. (*Chem. Geology*, i, 16.) If a salt of calcium were present, this reaction could only take place in the absence of carbonic acid, for carbonate of magnesia is incompatible with chlorid of calcium. The direct reduction and decomposition of sulphate of magnesia by organic matter and carbonic acid may, however, yield sulphuretted hydrogen and carbonate of magnesia, and thus, in certain cases, give rise to magnesian sediments.

69. In the preceding sections, we have supposed the waters mingling with the solution of sulphate of magnesia to contain no other bicarbonate than that of lime, but bicarbonate of soda is often present in large proportion in natural waters, and the addition of this salt to sea-water or other solutions containing chlorids and sulphates of lime and magnesia, will, as we have seen, (§ 1) separate the lime as bicarbonate, and give rise to liquids, which, without being concentrated brines as in the previous case, will contain sulphate of magnesia, but no lime salts. A farther portion of bicarbonate of soda will produce bicarbonate of magnesia, by the evaporation of whose solutions as before, hydrated carbonate of magnesia would be deposited, mingled with the carbonate of lime which accompanies the alkaline salt, and in the case of the waters of alkaline springs, the compounds of iron, manganese, zinc, nickel, lead, copper, arsenic, chrome, and other metals, which springs of this kind still bring to the surface. In this way the metalliferous character of many dolomites is explained, as also the frequent association of metals, such as copper, nickel, cobalt, chrome and titanium, with serpentine, steatite, diallage, olivine, and other magnesian silicates, which owe their origin to the alteration of magnesian sediments such as we have described.

* On certain modes of decomposition of the sulphates, see Jacquemin, *Comptes Rendus*, June 14, 1858.

70. As the separation of magnesian carbonate from saline wa-rs by the action of bicarbonate of soda does not suppose a very eat degree of concentration, we may conceive this process to on in basins where animal life exists, and thus explain the igin of fossiliferous magnesian limestones like those of the adswell (§ 53,) and the Silurian rocks of the western United ates, whose fossils, as I am informed by Mr. James Hall of lbany, are generally such as indicate a shallow sea. To the tervention of carbonate of soda is I conceive to be referred the igin of all those dolomites which are not accompanied by psums, and which make up by far the larger part of the mag-sian limestones; nor will the dolomites thus derived be neces-rily marine, for the same reagent with waters like those of the anube and Arve would give rise to dolomites and magnesites fresh-water formations, which unlike those mentioned in § 67, ould not be accompanied by gypsums.

71. To the first stage of the reaction between alkaline bicar-mates and sea water I am disposed to ascribe the formation of rtain deposits of carbonate of lime which although included fossiliferous formations, are unlike most of their associated nestones, not of organic origin, but have the characters of a emical precipitate of nearly pure carbonate of lime, in which e often imbedded silicified shells and corals.* It is not per-ps easy in all cases to distinguish between such precipitates, hich may assume a concretionary structure, (see on this ques-

* The large proportion of dissolved silica which many river waters contain (§ 64) pears in sedimentary deposits, not only replacing fossils and forming concretions d even beds of flint, chert and jasper, but also in a crystalline state, as is seen in crystallized quartz often associated with these amorphous varieties, and in some ds of sandstone which are made up entirely of small crystals of quartz. Elie de aumont long since called attention to the crystalline nature of certain sandstones ich as Daubrée has remarked, could not have been derived from the disintegra-n of any known rock, and Mr. J. Brainard at the meeting of the American Asso-tion for the Advancement of Science, held at Cleveland, insisted upon the crys-lline character of the grains composing sandstones in Ohio, as evidence that ese were chemical deposits. He however fell into the error of supposing that all ndstones and even quartzose conglomerates have had a like origin, while the ter and the greater part of the former are undoubtedly mechanical deposits from e ruins of pre-existing quartzose and granitic rocks.

These crystallized sands according to Daubrée, are met with in beds in the sand-ne of the Vosges, the variegated sandstone (Triassic and Permian,) in the tertiary the Paris basin and elsewhere. Other sands are made up of globules of calce-ny, apparently like the crystallized sands a chemical deposit, and associated with litic iron ores in the lias, and with glauconite grains in the green-sand. (Daubrée *cherches sur le Striage des Roches, etc.*, Ann. des Mines 1857, 6 livr.) We may re mention the so-called *gaize* from the green sand of the Ardennes, which gave to ivrage 56·0 p. c. of amorphous soluble silica mixed with quartz sand and glauco-e. (Bischof, *Lehrbuch*, i, 768–811.)

Maschke has shown that under certain conditions silica is soluble in about twenty-e parts of pure water; from this solution it separates by evaporation or by the dition of concentrated saline solutions in a form insoluble in water. (*Jour. für akt. Chemie*, lxviii, 288.) In these reactions we have a key to the formation of icious deposits.

tion Bischof, *Chem. Geology*, i. 428,) and those deposits which like travertines have been formed from subterranean springs. In neither case however, should they be confounded with the tufaceous limestones mentioned in § 63.

72. The union of the mingled carbonates of lime and magnesia to form dolomite, is attended with contraction, which in case the sediment was already somewhat consolidated, would give rise to fissures and cavities in the mass. Should the dolomitic strata be afterwards exposed to the action of infiltrating carbonated waters, the excess of carbonate of lime and any calcareous fossils would be removed, (§ 30,) leaving the mass still more porous, with only the moulds of the fossils. Insoluble however as it appears to be at ordinary temperatures, the filling up of such cavities both in magnesian and in pure limestones, not less than its deposition in veins and druses, indicates that dolomite is under certain conditions soluble.

The lowest temperature at which hydrous magnesian sediments may be transformed into magnesite and dolomite has yet to be determined. The requisite heat has however doubtless been attained by the accumulation of overlying sediments, in virtue of that law which causes the temperature to increase as we penetrate the earth's crust. This increase we may suppose with Mr. Hopkins to have been much more rapid in former epochs than at present.—(*Geol. Journal*, viii, 59, also Phillip's *Manual of Geology*, 609.)

Conclusions.

1. The action of solutions of bicarbonate of soda upon sea water separates in the first place the whole of the lime in the form of carbonate, and then gives rise to a solution of bicarbonate of magnesia, which by evaporation deposits hydrous magnesian carbonate.

2. The addition of solutions of bicarbonate of lime to sulphate of soda or sulphate of magnesia gives rise to bicarbonates of these bases, together with sulphate of lime, which latter may be thrown down by alcohol. By the evaporation of a solution containing bicarbonate of magnesia and sulphate of lime, either with or without sea salt, gypsum and hydrous carbonate of magnesia are successively deposited.

3. When the hydrous carbonate of magnesia is heated alone under pressure it is converted into magnesite, but if carbonate of lime be present, a double salt is formed which is dolomite.

4. Solutions of bicarbonate of magnesia decompose chlorid of calcium, and when deprived of their excess of carbonic acid by evaporation, even solutions of gypsum, with separation of carbonate of lime.

5. Dolomites, magnesites and magnesian marls, have had their origin in sediments of magnesian carbonate formed by the evaporation of solutions of bicarbonate of magnesia. These solutions have been produced by the action of bicarbonate of lime upon solutions of sulphate of magnesia, in which case gypsum is a subsidiary product; or by the decomposition of solutions of sulphate or chlorid of magnesium by the waters of rivers or springs containing bicarbonate of soda. The subsequent action of heat upon such magnesian sediments, either alone or mingled with carbonate of lime, has changed them into magnesite or dolomite.

ART. XLI.—*On Gallic and Gallhumic (Metagallic) acid;* by Dr. F. MAHLA, Ph.D., Chicago.

IT is mentioned among the reactions of gallic acid in almost every handbook of chemistry, that its solution produces a deep bluish-black color with a solution of the salts of the sesquioxyd of iron, which disappears, when the solution is heated. As I have nowhere found an explanation of this fact, I have tried to investigate it by some experiments.

When the solutions of the sesquioxyd of iron and gallic acid are used in a diluted state, the resulting mixture appears only slightly colored, but if they are concentrated, it assumes after being heated to ebullition, a dark brown tint, and then causes black spots on the skin, which can be washed away only with the greatest difficulty. Such a solution might perhaps be used advantageously as a hair dye.

If the iron-solution was not added in too large proportion, liquid ammonia no longer precipitates hydrated sesquioxyd of iron, but the proto-sesquioxyd (black oxyd). A reduction takes place therefore, the oxygen transforming some of the carbon of the gallic acid into carbonic acid, which is freely evolved during the ebullition.

To a portion of gallic acid, dissolved in water and heated to ebullition, a solution of sesquichlorid of iron was carefully added in small quantities and the mixture heated again after each addition. This treatment was continued, until a drop of the solution mixed with a little water ceased to give the characteristic bluish-black precipitate of gallic acid with sesquichlorid of iron. A solution of carbonate of soda was then added in slight excess and the black precipitate separated by filtration. A portion of the filtered dark-brown liquor, after being exactly saturated with hydrochloric acid, deposited a voluminous black precipitate, which if dried, formed a black shining mass but when freshly

precipitated, was easily redissolved by free muriatic acid. Such a solution, containing but little free muriatic acid, produced black insoluble precipitates with limewater, with the different salts of lime and baryta, with sulphate of zinc and sulphate of copper. Another portion of the filtered liquor super-saturated with acetic acid, caused precipitates of a black color in solutions of acetate of lead and nitrate of silver. From the silver precipitate, metallic silver was soon separated.

The lead precipitate was carefully washed with distilled water, and after being dried in an air-bath at a temperature not exceeding 200° F. (94° C.) for ten hours, it was heated over a spirit lamp, until the organic matter was perfectly destroyed. The residue, consisting of a mixture of oxyd of lead and metallic lead, was treated with acetic acid, and from it the whole quantity of oxyd of lead was calculated.

1·052 gram. gave 0·662 of the mixture of PbO+Pb, which left after being treated with acetic acid 0·037 metallic lead, a quantity corresponding to 0·041 oxyd of lead. The acetic acid extracted 0·625 oxyd of lead, which quantity added to the above found 0·041 gives 0·666. This is equal to 63·30 per cent.

Gallhumic (metagallic) acid, which was detected by Pelouze in the residue of distillation, when gallic acid was suddenly heated to 480° F. (249° C.) shows the same reactions, and its lead salt, 2PbO, $C^{12}H^{3}O^{3}$, contains 63·04 per cent of the oxyd of lead. No doubt can therefore exist about the identity of Pelouze's acid and my product. Two equivalents of gallic acid are divided exactly into one equiv. of gallhumic, two equiv. of carbonic acid, and three equiv. of water:

$$C^{14}H^{6}O^{10}=\left\{\begin{array}{l}C^{12}H^{3}O^{3}\\ C^{2}\quad O^{4}\\ \quad H^{3}O^{3}\\ \hline C^{14}H^{6}O^{10}\end{array}\right.$$

This origin of gallhumic acid forms another and interesting argument, that pyro-acids can be obtained otherwise than by the action of heat.

If some powdered "red precipitate" is added to a solution of gallic acid and heated over a spirit lamp, it is immediately reduced; gallic acid precipitates suboxyd of copper (red oxyd) in a solution of sulphate of copper; this reaction appears with the greatest facility if the solutions are heated together. It also reduces a cold solution of neutral chromate of potassa, producing the green sesquioxyd. The gallic acid is in each of these cases transformed into gallhumic acid. The action of these substances on gallic acid and the formation of the new product, is explained by assuming gallhumic acid to be only an intermediate product, the final result being carbonic acid and water.

ART. XLII.—*The Great Auroral Exhibition of August 28th to September 4th*, 1859.

ON the evening of August 28th, 1859, was commenced an exhibition of Auroral or Polar light which continued with varying intensity at different localities in North America, so far as is now known, up to September 4th. This auroral display is one of the most remarkable ever recorded in the United States; remarkable not only for the great extent of territory over which it was observed, but also for its duration, for the intensity of the illumination as well as the brilliancy of the colors, and the extreme rapidity of the changes. It was also equally remarkable for the magnetic disturbances which accompanied it, especially on the 2d and 3d of September. These electrical perturbations were recorded not only by the usual magnetic instruments, but over the whole system of telegraphic wires, especially in New England and the Canadas, the magnetic induction either greatly interfered with or prevented the working of the lines by the usual voltaic current, while in more than one case the north and south lines were worked during the daytime of September 3d solely by the atmospheric influence! This remarkable and novel phenomenon deserves and will receive special attention hereafter.

It appears from our own correspondence, and from the daily Journals, that the late display of the Aurora was witnessed from Cuba and Jamaica on the south, to an unknown distance beyond the Canadas on the north, and from Central Europe on the east, to California on the west. Doubtless we may expect to hear that it was seen over the entire northern hemisphere, and in some places as far south as lat. 20°.

Since the laws of this phenomenon are as yet but imperfectly understood, it is regarded as very important that the facts respecting the late grand exhibition should be carefully collected and placed on record, in the expectation that at some future day they may afford the basis for a complete and satisfactory theory of this meteor.

We now publish such original observations on this Aurora as have reached us in an authentic form, and we hope in future numbers of this Journal to present many other important data of the same description from different and distant parts of this and the other continent. We intend to present in the first place the *facts* of this exhibition divested of all theoretical considerations; and when all the materials have been collected we shall give such explanation of them as we are able. At present we put on record observations of the aurora and its attendant phenomena made at Lewiston, Me.; at Toronto, Canada West; at New Haven, Conn.; at West Point, N. Y.; at Bloomington,

Ind.; at Springhill, Ala.; at Jefferson Co., Miss.; at Havana, Cuba; and at San Francisco, California. All but one of these having been communicated to this Journal directly from their authors.

1. *Observations made at Lewiston, Maine*, lat. 44° 5′ N., long. 70° 15′ W.*;* by Prof. ELIAS LOOMIS.

Sunday, the 28th of August, I passed at Lewiston, in the state of Maine. The day was throughout unusually cold and very windy. In the evening, the wind was less violent, but still fresh from the northwest, and so continued until midnight. At 10 P. M. the thermometer stood at 53° F. and the next morning at 5 o'clock it stood at 50° F.

At $8^h\ 20^m$ in the evening I first noticed some remarkable auroral indications. Long brushes of pale white light were shooting up from the west and also from the east, and were directed towards a point considerably south of the zenith; while in the northwest was a large mass of light tinged with a decided rosy hue.

At $8^h\ 35^m$ P. M. the light in the east and northeast had also assumed a rosy tint, while that in the northwest had acquired a deeper red color. At the same time a dark segment rested upon the southern horizon, its vertex having an altitude of about fifteen degrees above the horizon, and its convex edge was bordered throughout by a vivid light which was nearly white but with a decided tinge of emerald-green. In the north was also seen a dark bank similar to that in the south, but less sharply defined, and rising to an altitude of about 30°.

At $8^h\ 45^m$ P. M. in nearly every part of the heavens the light had become more intense, and the streamers were continually varying both in position and in the intensity of their light, presenting the appearance of undulations. From nearly every quarter of the heavens the streamers converged towards one point, but terminated about ten degrees before reaching that point. That point was nearly equidistant from the three stars *Lyra*, *Altair*, and *α Cygni*, but somewhat nearer to Lyra.

At $8^h\ 55^m$ P. M. the elevation of the bank resting on the southern horizon did not exceed five degrees.

At 9 P. M. the light had broken through nearly the entire dark bank in the north, so that there remained only a portion of this bank of very irregular shape, and its average height did not exceed ten degrees. The point of convergence of the streamers was now about equidistant from the three bright stars above named, but inclining a little to the north of that central point.

At $9^h\ 5^m$ the illumination of the southern half of the heavens was much greater than that of the northern; but at $9^h\ 10^m$ the illumination of the southern half had sensibly declined and the

dark bank resting on the southern horizon had risen to a height of 15° or 18°.

At $9^h\ 18^m$ the point of convergence of the streamers was nearly equidistant from the stars above named, but somewhat nearer to *α Cygni*.

At $9^h\ 23^m$ the dark segment in the south was quite regular, and not more than ten degrees in height, and the bright border was very strongly illumined; while the dark segment in the north had almost entirely disappeared, and there was but little light in the northern portion of the heavens, nearer the north horizon than about forty degrees.

At $9^h\ 33^m$ a narrow beam of white light shot up from the west and another similar beam shot up from the east, which met at the magnetic zenith, forming a pretty well defined bow, and being nearly half of a great circle of the sphere. Throughout the entire portion of the heavens north of this arc, there was scarcely any trace of auroral light; while in the south the dark segment was complete, and the diffuse illumination above it was very strong; that is, the usual conditions of the aurora were entirely reversed, and it now appeared wholly on the south side of the zenith, with its base resting on the south horizon.

At $9^h\ 49^m$ P. M. the aurora was entirely confined to a region not rising more than 40° above the southern horizon, and it seemed as if the light was entirely disappearing, passing away towards the south, when very suddenly it increased in brightness, and rose higher in the heavens. Soon it became so bright that I could read with perfect ease the finest printed type. I took from my pocket a paper printed in *nonpareil*, (the finest type often used by printers,) and could read it by the light of the aurora with the same facility as at noonday. The streamers now converged to a point nearly midway between *α Delphini* and *α Cygni*. Soon they covered the entire heavens, reaching down almost to the north horizon. The light in many places, particularly in the south, at an elevation of about 45°, became of a brilliant crimson, and then commenced a succession of flashes like waves of light rolling up towards the magnetic zenith.

At 10 P. M. the point of convergence of the streamers was about equidistant from *α Delphini* and *α Cygni* and about three degrees east of the line joining those two stars. The flashes still continued, but the illumination was less intense.

At $10^h\ 10^m$ P. M. the light had become very pale and diffuse, particularly in the north.

At $10^h\ 14^m$ P. M. almost the entire heavens appeared of that dull slate color which usually characterizes the dark segment near the horizon; but at $10^h\ 19^m$ the whole heavens brightened up again with diffuse brushes of straw-colored light, all inclining towards the magnetic zenith.

At $10^h\ 24^m$ P. M. the point of convergence of the streamers was about equidistant from *α Delphini*, *α Cygni* and *Eta Pegasi*.

At $10^h\ 30^m$ P. M. the corona was very perfect, but the light was chiefly of a straw color, and much paler than it had been about ten o'clock.

At $10^h\ 45^m$ P. M. irregular streamers of pale light covered the entire heavens with the exception of a segment rising about thirty degrees above the southern horizon.

Soon after 11 o'clock I retired, but slept little during the night. The light of the aurora continued until day-light, and made my room nearly as light as a full moon would have done; and I frequently rose to observe the phenomenon from my window, which had a free northern exposure.

At 12 o'clock (midnight) the whole northern half of the heavens was covered with streamers of a diffuse yellow light, and whose borders were not sharply defined.

Aug. 29th at 2 A. M. the whole sky was covered with a haziness, while a number of light clouds of considerable extent were visible, and the whole was lighted up as by a full moon shining through them.

At 5 A. M. the sky seemed unusually clear with the exception of a few light clouds, mostly cirro-stratus, scattered irregularly over the heavens; but near the north horizon was a collection of cirro-stratus clouds forming together a bank rising to an elevation of about eight degrees, and similar to the dark segment observed last evening.

I subsequently ascertained that on the evening of Aug. 28th, snow and sleet were falling upon the summit of Mount Washington (the highest of the White Mountains in New Hampshire), and this snow remained unmelted for several days.

2. *Observations at Toronto, Canada West*, lat. 43° 39′ 35″ N., long. 79° 21′ 30″ W.; by Prof. G. P. Kingston, Director of the Magnetic Observatory. (In a letter to the Editors).

Magnetic Observatory, Toronto, Canada, Sept. 24, 1859.

Dear Sirs:—According to the promise conveyed to you in my note of yesterday I send you some facts relating to the Aurora of 28th August and following days. These facts you will notice are not given in a form suitable for publication, but must be considered only as materials for you to work up in the manner best adapted for your purpose.*

* Prof. Kingston's letter was accompanied by a copy of his magnetic records for the two days named—Sept. 2d and 3rd—taken every *fifteen* or every *five* minutes, and for a part of the time every *two* minutes during the hours of observation. These records are extremely interesting and will undoubtedly be presented in full in the records of the Observatory. We have condensed from them the brief table here given.—Eds.

In the magnetical observations the readings of the instruments have been compared with the normal standard readings proper to the time of observation, and the excess or defect from the standard have been then expressed in arc for the declination and dip and in parts of the horizontal and vertical forces respectively for those components of the force. The times of observation are expressed in hours and minutes Göttingen astronomical time. By these means the tabulated numbers are independent of instrumental peculiarities and of local time, and are therefore comparable with results similarly obtained from other quarters. That the deviations given are extraordinarily great will be apparent when it is considered that according to the rule adopted by General Sabine a disturbance is reckoned *large* when the declination differs 5′ the dip 1′ the horizontal force ·0012 and the vertical force ·00026 from their several normal values. Prior to the morning of Sept. 2, the instruments occasionally gave evidence of a disturbed condition of the magnetic elements but not to such an extent as to lead to any systematic reading of them excepting at the regular hours of observation. The Aurora first appeared about 7 : 40 P. M. of Sunday Aug. 28. From which time through the *whole night* the *whole sky* was covered with a brilliant mass of streamers, patches and luminous bands, which rose from all points of the horizon, the predominant color being yellow intermixed with patches of crimson.

At $8^h\ 10^m$ along the *south* horizon was seen a low bank of dark haze similar to that which is common on like occasions in the north horizon, and from which streamers occasionally issued extending towards the zenith and forming with streamers that converged from other points a corona about 16° south of the zenith.

At $8^h\ 25^m$ dense masses of red streamers extended in a band from N.W. to S.S.E., with an intermixture of crimson patches.

On the whole the aurora of Aug. 28 seems to have been characterized not so much by the activity of the phenomena as by the *extent* of the sky which it occupied, (the whole hemisphere,) and by the permanence; for there was little variation in the kind or intensity of the phenomena through the night.

On Aug. 29—Faint auroral light from 8 : 30 in the night, being clear and favorable for observation.

Aug. 30—Sky overcast.

Aug. 31—Clear and unclouded but no aurora recorded.

Sept. 1—Overcast till near midnight. When the sky cleared auroral light was seen accompanied by streamers. At $12^h\ 30^m$ a fine corona was formed round a point 28° S. of the zenith.

Sept. 2—Generally overcast with auroral light occasionally visible through the clouds.

Sept. 3—Aurora visible from sunset consisting of streamers with the formation occasionally of imperfect corona.

Sept. 4—Auroral light with occasional streamers.

Sept. 5—Unclouded, faint auroral light.

Magnetic Disturbance at Toronto, 2nd and 3rd Sept., 1859. *Table giving the variation of the Declination, Inclination, Horizontal and Vertical Forces, from the respective normal values.*

The variations of the declination and inclination are expressed in minutes of arc, and those of the horizontal and vertical forces in parts of the horizontal and vertical forces respectively.

— denotes a westerly deviation or increase of westerly declination and a decrease of dip and of force.

Göttingen time.	Declination.	Inclination.	Horizontal Force.	Vertical Force.	Gottingen time.	Declination.	Inclination.	Horizontal Force.	Vertical Forces.
D. H. M.	° ′	° ′			D. H. M.	° ′	° ′		
2·0·00	9·5	7·7	—·0191	·0028	8·00	14·1	− 2·8	·0024	·0039
·15	41·0	11·1	—·0129	·0039	9·00	11·3	− 2·0	·0016	·0040
·30	52·2	17·4	—·0233	·0033	·30	4·2	− 4·0	·0045	·0047
·34	12·6	16·9	—·0171	·0019	2 10·20	33·3	− 14·4	·0130	·0060
·42	— 40·3	25·0	—·0256	·0012	11·00	11·3	− 9·6	·0095	·0047
·48	16·6	26·1	—·0275	·0019	·10	— 9·7	− 10·8	·0113	·0050
·52	— 40·3	8·6	off scale	—·0027	13·00	6·6	− 1·6	·0044	·0045
1·00	33·1	1 7·3	—·0611	·0001	13 30	43·3	− 18·8	·0268	·0089
·04	— 16·6	46·9	—·0393	·0027	14·00	8·3	3·2	—·0027	·0044
·06	28·7	1 4·9	—·0601	·0036	15·05	— 31·3	13·2	—·0179	·0006
·08	67·6	24·6	—·0672	·0036	·45	22·7	40·0	—·0064	·0021
·10	— 13·7	1 19·6	—·0647	·0027	16·00	— 16·6	16·8	—·0174	·0031
·12	2 6·7	1 20·5	off scale	—·0022	·15	1 4·9	24·8	—·0120	·0006
·20	— 2·9	1 37·3	—·0765	·0025	17·00	— 6·3	3·6	—·0061	—·0014
·26	1 35·0	1 14·5	—·0717	·0056	·45	— 24·0	13·2	—·0015	—·0007
·36	1 41·2	1 42·5	—·0741	—·0013	18·00	— 10·4	9·2	—·0096	·0002
·40	54·4	1 16 9	off scale	—·0003	3 4·00	8·9	5·8	—·0056	·0021
·48	2 6·4	1 0·5	"	—·0031	·10	1·2	4·6	—·0044	·0016
·50	11·2	Off scale	—·0809	Off sc'le	·50	51·1	14·3	—·0146	·0026
·56	27·7	2 29·8	—·0857	—·0057	5·25	18·0	15·6	—·0127	·0034
·04	1 24·2	45·7	—·0566	·0000	·30	40·3	17·2	—·0167	·0033
·06	51·8	51·7	—·0549	—·0006	·40	2·2	18·0	—·0168	·0037
·16	—1 37·2	Off scale	—·0583	—·0021	6·00	— 11·9	15·2	—·0104	·0041
·34	1 26.0	1 16·9	—·0748	—·0005	·15	— 16·3	13·6	—·0081	·0040
·36	49·3	1 25·7	—·0724	—·0032	7·00	— 5·8	2·4	0000	·0043
·46	2 7·8	1 39·3	—·0630	—·0021	8·00	5·1	0·4	·0022	·0035
·58	57·8	47·7	—·0501	·0006	9·00	— 4·2	7·2	—·0032	·0023
·08	— 29·3	49·3	—·0472	—·0009	10·00	— 14·5	8·4	—·0063	·0023
·24	1 7·2	32·8	—·0406	·0003	3 11·00	1·5	8·0	·0067	·0021
·36	— 10·6	36 8	—·0360	·0000	12·00	6·1	− 0·8	·0028	·0037
·40	— 0·4	29·2	—·0275	·0013	13·00	31·0	− 18·8	·0185	·0037
4·00	32·8	22·8	—·0232	·0038	14 00	5·4	− 0·4	·0006	·0024
·16	8·6	22·0	—·0204	·0031	·05	1·1	1·6	·0011	·0023
·24	22·3	21·6	—·0147	·0035	·35	17·1	− 0·4	—·0014	·0012
·32	2·5	17·6	—·0154	·0041	·50	— 1·8	4·0	—·0025	·0012
·42	23·8	8·4	—·0128	·0039	15·10	— 4·0	4·4	—·0022	·0025
·52	— 1·4	12·4	—·0109	.0037	·35	29·0	4·4	—·0083	—·0012
5·02	14·8	15·2	—·0147	·0038	·45	— 32·8	7·6	—·0090	—·0012
5·18	— 4·3	10·4	—·0080	·0038	·55	— 16·2	9·6	—·9122	—·0012
5·45	15·1	5·2	—·0069	·0034	16·15	— 5·9	8·0	—·0080	—·0013
6·35	1·7	3·2	—·0043	·0027	·30	— 19·6	7·2	—·0059	—·0012
7·10	9·0	1·2	—·0024	·0040	3 17·00	— 13·2	6·8	—·0064	·0060

3. *Observations at New Haven* (lat. 41° 18′ 27″), by Prof. C. S. LYMAN of Yale College.

The Auroral display of Aug. 28th attracted attention at New Haven before the disappearance of daylight; and at $7^h 40^m$ mean time, when first seen by the writer, the whole northern quarter of the heavens was covered with a diffused, hazy light, rapidly changing its appearance, often of a crimson or yellowish hue, with occasional streamers, and with a denser mass of light, as usual, above the northern horizon. At $7^h 45^m$ this light reached the zenith; at $7^h 55^m$ it had passed 25° or 30° further south, and the marginal portion formed for a few minutes, an irregular belt or zone made up of evanescent fragments of arches, intermingled with streaks and patches of auroral light. No distinct bow, however, was at any time formed. At $8^h 15^m$ this portion had nearly vanished, and the southern edge was only 3 or 4 degrees below *alpha Lyræ*, then near the meridian. Eight minutes later the edge touched *alpha Aquilæ* and in three minutes more was about 10° south of it. This southern margin was at times quite definite, and as it moved gradually towards the south the following notes were made of it at the time—the altitudes (near the meridian) being measured with a pocket quadrant, and probably in error less than half a degree.

At 8^h	27^m		alt. of	edge	28°		
8	29		"	"	20°	30′,	bright and regularly arched.
8	30	30^s	"	"	17	15,	bright.
8	31	20	"	"	15	45,	bright, broad, edge well defined.
8	33	15	"	"	14	0,	at star Epsilon Sagittarii.
8	34	30	"	"	14	0,	bright, and well defined.
8	35	30	"	"	12	30,	bright, and very well defined.
8	37	40	"	"	11	20,	edge, well defined.
8	38	30	"	"	10	40,	nearly the minimum alt.
8	40	15	"	"	12	45,	receding, 30′ or 40′ below star ε Sag.
8	42	0	"	"	10	30,	second arch, first 4° or 5° above.
8	47	0	"	"	12	30,	bright, edge well defined—at star ε.
8	49	30	"	"	12	30,	edge at same star.

At this time a small bright horizontal cloud of light some 2° wide and 5° or 6° in length, and pointed at each end, formed rapidly, near the meridian, in the open sky just below the arch at an altitude of 9° 50′, and moved slowly to the west parallel to the arch, through a distance of 15° or 20° till it was lost to view behind trees, about a minute, by estimate, after its formation. This cloud appears to have been identical with one seen by Prof. A. C. Twining at West Point.

The star *epsilon Sagittarii*, referred to above, is found by computation to have had an altitude at $8^h 33^m$ of 13° 36′, being then 45^m past the meridian. Its altitude at $8^h 50^m$ was 12° 58′. When on the meridian at $7^h 48^m$ it was 14° 18′.

At 8^h 52^m, arch at the south growing fainter and breaking up. In a few minutes that quarter of the sky was nearly free from light.

At 8:54 an imperfect corona formed at an altitude of 69°. At 8:56 a better one with bright wisp at its center, alt. 72°. At 8:58½, corona 72½° apparently in vertical plane cutting *alpha Aquilæ*. (Azimuth of the star then, by calculation, 8° 22′ E.) The corona at these times not very definitely formed.

At 9^h 5^m, a bright mass of light noticed in the east, irregular, expanding, and stretching obliquely upwards and towards the south. At 9^h 10^m this was met by a similar irregular mass of light stretching around simultaneously from the west, forming an imperfect band or arch, with very little light below it, its lower edge at this time having an altitude of 27° on the meridian. At 9^h 12^m its altitude was 20° 30′, at 9^h 23^m, 16° 15′, and at 9^h 31^m, 16°, soon after which it faded. While this second curtain was shutting down in the south, it was noticed that the light in the north was rising gradually. At 9^h 26^m 30^s its lower edge passed Polaris, and three minutes later was at an altitude of 62°, leaving the sky below nearly free from auroral light. At the same time, the phenomena overhead began to be more active and brilliant, streamers and cloudy masses of light of various hues, chiefly crimson, forming and vanishing about the corona, attaining a maximum of splendor from 36 to 43 minutes after 9, and at 49^m having become comparatively faint. This magnificent *umbrella-like* canopy, first formed by these tinted streamers and flashes about 9^h 33^m, and then extending not more than 30° or 40° from the corona, with an irregularly scallopped or fringed margin, rapidly expanded in all directions, being more brilliant towards the north, and there presenting the appearance of a descending curtain, or rather succession of curtains, until at 9^h 38^m, it had shut down to the horizon all round, except in the south. The magnificence of the display at this time was not surpassed by anything in the brilliant Auroras of 1837, as remembered by the writer. The curtains just mentioned had at one time something of the drapery-like appearance characterizing the Auroras seen by the French commission at Bossekop in 1838-9.

Although the position of the corona is known to coincide in general with the direction of the dipping needle, its altitude was several times noted with a view to ascertaining its fluctuations, if any. The coronal point, however, was seldom or never sufficiently definite to make the observations of much value for this purpose. In addition to the notes of the coronas before 9 o'clock given above, the following were also made at the time.

At 9^h 15^m 30^s altitude of C. 73°, very definite.
9 18 bright streak or cloud above C. (alt. 76°) lasted $1\frac{1}{2}^m$.

At 9^h	22^m		alt. 73°,	fine corona, long streamers.
9	24	30^s	" 68° 30′,	bright wisp near corona. C. not definite.
9	26	30	" 72 15,	good corona.
9	28		" 73 15,	" "
9	30	40	" 73 0,	coronal cloud with rays from it.
9	33		" 73 40,	definite, dark center of grand corona.
9	34	30	" 74 30,	very fine and definite.
9	36	30	" 75 15,	C. not definite, colored streamers, splendid canopy.
9	38		" 72 45,	tints brilliant.
9	40		" 74 0,	C. definite, bright red, whole display magnificent.
9	41	30	" 74 0,	splendid.
9	49		" 73 45,	display much less brilliant.
9	52 to 58,			brilliant flashes and pulsations, chiefly towards corona.
9	53	10,		a shooting star appeared about 15° above Polaris, moving rapidly towards the west over an arc of 15° or 20°.
9	58			Auroral light diffused, faint—colored flashes.
10	0			very little except in north.

Flashes and pulsations continued with varying brilliancy until after 11 o'clock, and according to the testimony of others, the display continued through the night, at times with much splendor.

The mean of the above altitudes of the corona is about 73° 20′. The dip at New Haven is about 73° 50′.

A similar display of rosy streamers and waving light, though less brilliant, was witnessed on the morning of Sept. 2, after midnight, as noticed in one of the morning papers. It was observed about daybreak by Prof. Forrest Shepherd, whose attention was particularly attracted by the rapid flashes and pulsations overhead, which seemed to him to indicate a very low elevation of the phenomena above the earth.

The display was continued on the evening of the same day, being most brilliant between 9 and 10 o'clock when the whole northern heavens to the zenith, and often beyond, was filled with upward flashes and pulsations here and there, chiefly of whitish light, and with but few streamers.

On Sunday evening Sept. 4th, there were indications of a bright Aurora, though a clouded sky prevented it from being particularly observed.

Auroral indications were also noticed on some other evenings of the preceding week.

Unfortunately no magnetic observations were made at New Haven.

The time piece used in noting the phenomena of the 28th was compared the same evening with the astronomical clock of the writer's observatory, and found to be only 5 seconds fast of N. H. mean time.

4. *Observations of Prof.* ALEXANDER C. TWINING *on the Aurora of Aug. 28th,* 1859, *made at West Point, New York.*

While the evening twilight was yet so strong as to make the phenomenon scarcely discernible, a rosy hue was seen spreading over a space reaching from the northeastern horizon to the north star and thence to my zenith, of uniform breadth throughout, and bounded south by a line through Alpha Lyrae, passing vertically down to the east. The time was $7^h\ 25^m$ by the watch—which however varied six minutes from true local time (too fast it is believed, making the local time $7^h\ 19^m$). In about ten minutes the southern boundary moved to Alpha Aquilae, and the rosy light had extended itself visibly over to the west, and streamers were seen in the northeast. Very soon the northern sky became variegated nearly up to the zenith with advancing bands and flakes of yellowish and reddish cloud with streamers intermixed. At a quarter before eight o'clock, by estimation of the true local time, the streamers in the north were numerous; and by careful observation they were perceived universally to move towards the west.

At $8^h\ 35^m$ (by the watch) I looked again. A corona was then formed, and the auroral clouds and streamers were colored with tints of red and yellowish white. The most remarkable phenomenon was exhibited at the southern margin of the illumination. A yellowish cloud of extraordinary density and low altitude was seen advancing southward with an even and massive boundary which stretched entirely across the sky, in striking contrast with the clear blue beneath. It advanced beyond the bright star Antares, but soon receded and took a position which it retained ten or twelve minutes in a nearly level line exactly through that star, and a degree and a half, by estimation, below the star Epsilon Sagittarii. Its altitude therefore during that period—say from $8^h\ 40^m$ to $8^h\ 50^m$ (local time)—was about $11\frac{1}{4}°$, at the first named star, and about $11\frac{3}{4}°$ at the last:—at the meridian it was, probably, 12°. This southern line gave an opportunity for comparative observations in different latitudes, which, if improved, will determine the height of that auroral cloud with an unparalled certainty and accuracy. There was also during this period another phenomenon equally remarkable and, if extensively observed in widely different latitudes, equally valuable. Ten or fifteen minutes before nine o'clock a bright spot formed at or near the meridian, and three or four degrees below the above named level margin. It soon became a long and narrow cloud—say 8° long and $2\frac{1}{2}°$ broad at the middle—but pointed at its eastern and western extremities. It moved to the west in the clear sky, and parallel to the cloudy margin above it. In its course it passed centrally over the pair of

bright contiguous stars in the end of the Scorpion's tail,—showing an altitude, at the cloud's middle line, of 7°. In two minutes—as I estimated from subsequent recollection—it moved about forty degrees. It then was hidden by the mountains in the vicinity. Soon after this disappearance it was observed that the entire expanse of cloud in the south from the zenith down was making a similar progress west,—at about the same rate, as nearly as could be estimated. At $8^h\ 52^m$ (local time) the original mass of vapor had moved nearly out of the southern field—leaving a far less dense and bright accumulation of cloudy strata over all that quarter.

At twenty minutes to a quarter before ten o'clock I observed again. The corona was then finely formed by streamers thickly and completely developed on every side. In about three minutes the display became suddenly very gorgeous, the red and white (yellowish-white) streamers and banks being very brilliant. So they continued for a quarter of an hour at least. In this period pulsations or auroral waves were seen propagating themselves rapidly upwards, and quite to the corona. That these did move upwards was determined by a close scrutiny. The *dome* was completed on every side. The southern streamers were particularly observed to originate beneath in a line or arch which I roughly, and without express verification, judged to be at about the altitude of the cloudy margin as observed at a little before nine o'clock. It may have been somewhat higher. At ten o'clock, or a little earlier, the phenomenon of the narrow cloud moving westward was strikingly repeated. The cloud however in this instance was longer and less definite in shape.

From ten o'clock to $12^h\ 15^m$ I did not observe. At this last mentioned time the auroral twilight shone brilliantly in the north, but my view in that quarter was obstructed.

I observed again from $2^h\ 45^m$ to 3^h. The corona and dome were more regularly and completely formed than previously at ten o'clock, and more than I have seen them in either of the grand auroras of the last thirty years. The streamers were narrow, thick set, evenly distributed, and traceable to the corona. High in the north, observed against the constellation Cassiopeia, they moved across it from west to east, contrariwise to the motion in every instance I have before observed in any aurora. Yet my morning observations on this particular (and nearly or quite universal and yet generally unnoticed) phenomenon of transverse motion have not been so numerous as at evening.* At the spot

* My conjecture as to the occasion of this remarkable feature of auroral phenomena has heretofore been the following:—a *streamer* may be taken as the visible path of some portion of an electric current, normal, or nearly so, to the great thermal current of the earth. Such a normal current, in conformity with known laws, will experience a lateral movement under influence of the thermal current. It will also act upon the latter,—thus affecting magnetic intensity at the earth's surface, and,

observed the motion was estimated as being fully 20° per minute. The ever varying wisps of cloud at the corona, and the southern streamers were also moving to the east. I left the display in full action without observing farther.

The repetition which took place Sept. 3d, although on a vastly diminished scale of grandeur, I observed about one hour,—say from 9^h to 10^h P. M. It was remarkable for the character of the auroral waves, which passed upward, illuminating successively different definite spaces in their path. The motion of these waves was far more moderate than I have ever before remarked. In this instance I could not estimate it to exceed forty-five degrees of arc in a second of time. The movement was everywhere distinctly upward; but the determination of arcual or angular motion in this phenomenon, is excessively difficult and inexact.

5. *Two letters from Prof. Daniel Kirkwood, Bloomington, Ind.*

[*First letter.*]

Aug. 29th, 1859.

TO THE EDITORS, &c.

Gentlemen:—The most extraordinary display of the Aurora Borealis I have ever witnessed was seen from this place last night. It was observed immediately after the close of twilight, and, in the course of an hour, the whole northern horizon from east to west was illuminated. *The phenomenon continued from twilight to twilight;* the brilliancy being greater at 4 o'clock this morning than at any previous hour. It was the lightest moonless night our citizens have ever known. Tints of various colors were seen in different parts of the heavens; but what struck spectators generally with wonder was a thin, gauzy cloud of brilliant red, which appeared first in the east about 9 o'clock in the evening, and which seemed to move almost horizontally till it reached the northwest; at 9^h 30^m lying precisely over the stars *Alioth*, *Mizar* and *Benetnash*, where it took the form of streamers, converging towards a point somewhat south of the zenith. At the same time an arch of light appeared, having one extremity in the horizon beneath, or rather westward of,

almost of necessity the declination and dip; which seem to be merely resultants of all the electro-dynamic actions upon the needle, subsisting at the time. Under the above hypothesis, therefore, every development of streamers must ordinarily concur with three other phenomena, viz., a lateral movement of the streamers, a change of the needle's direction, and a change of magnetic intensity. The hypothesis of a magnetic property in the auroral medium—whatever the latter be—seems wholly gratuitous. It is only requisite that the medium, or substance through or along which the current passes, shall be susceptible of illumination by such passage. Certain phenomena however indicate that the current transports the auroral vapor laterally with itself. The importance of this class of observations to questions relating to the cause of the aurora, as well as to the direction of currents, is obvious.

these red streamers, the other in the southeast; the zenith distance of its summit being about 40°, and its outer edge just reaching *Arcturus.*

Subsequently a splendid corona was formed, towards which the streamers moved in beautiful undulations. The most remarkable feature in the phenomenon, however, was its *extent;* not only the entire northern part of the visible hemisphere was illuminated, but the greater portion also of the southern.

I have just learned that during the night some lines of the magnetic telegraph were so much disturbed as to stop communication between different points.

[*Second letter.*]

Bloomington, Indiana, Sept. 9th, 1859.

TO THE EDITORS, &c.

Gentlemen:—Since the date of my hasty note of the 29th ult., we have had several more displays of the Aurora. Not having witnessed them myself, however, I have collected from others the following facts in regard to them: the first—a magnificent one—was seen by many of our citizens on the night of September 1st. It was noticed in the north about 11 o'clock, and gradually increased in brilliancy and extent until *the whole visible heavens were illuminated;* the light at times being such that ordinary print could be read without much difficulty. At 1 o'clock in the morning the portion of the heavens in which the light was most intense was almost exactly southeast, about midway between the zenith and horizon. The Stark County (Ill.) News thus describes the phenomenon:—

"On yesterday morning, (Sept. 1st) between one and two o'clock, the whole heavens were aglow with deep red light, which presented every variety of beautiful aspect imaginable. When we first looked out, it looked as if two brilliant suns had just set, one in the east and one in the west, and the sky, at either point was painted in broad streams of crimson and gold. This lasted but a moment, then a deep glow overspread the whole sky, brighter at some points than others, but all red. The light was so strong at times, that we could see to read fine print with ease, and gave to buildings and other objects, a dim glow, like fire-light. An arc of some 20° was formed over the southern horizon, the inside of which presented a silvery appearance like the edge of a cloud brightened by the moon, and from this, broad streams of a lilac color would flash up toward the zenith and abruptly end."

The displays on the nights of the 1st and 2nd, are described by the Indianapolis Journal of the 3rd inst., as follows:—

"*Another Aurora.*—Yesterday morning (Sept. 1) from midnight till day another Aurora, more brilliant than the first, in this locality at least,

was witnessed by those who had the good luck to be up at that time. At half past 11 o'clock it was quite brilliant, as a low arch of pure white light in the north, with but few radiations of colored light, and none that rose very high. It was very luminous, we could see as plainly as by moonlight, when the moon is quarter full, though the light was a paler and more ghastly kind, more like faded daylight than moonlight. Later in the night it grew much brighter still, and extended over the whole visible heavens. A beautiful column of red rays rose in the northeast, and another rose in the northwest, and met in the zenith, and from this point of junction a flood of red light poured out over the sky running down to the horizon on all sides, south as well as north, and the whole earth colored under its beautiful but ghastly crimson. Many who saw it say it was far more brilliant than the one of Sunday night, and it certainly was much more luminous, though less marked by the darting rays and wonderful pulsations that made the first so splendid. It was seen at Cincinnati, and all over the Union, we suppose, as the first one was. Such frequency and splendor of Auroras at this season we never saw or heard of before.

" *Still another.*—Another very beautiful Aurora Borealis was seen last night (Sept. 2) about half past eight o'clock. At that time it was confined to the north entirely. The rays shot up in very distinct cones or peaks of light, and beautifully variegated in color.

On Monday the 5th, about 2 o'clock in the morning, the phenomenon was witnessed for the fourth time within a week. Several beautiful streamers shot up from the northwest towards the zenith. The light, however, was of short duration.

It may be proper to remark that last evening, the 8th, about 9 o'clock, notwithstanding the bright moonlight, indications of the Aurora were again discoverable.

6. *On the Meteorological and Magnetic Phenomena accompanying the Aurora Borealis of Aug. 28th,* 1859, *as observed at Springhill (near Mobile), Alabama;* by Prof. A. Cornette, S. J.

I have thought that the meteoric conditions which preceded, accompanied and followed the Aurora Borealis of August 28th would be read with interest by all who witnessed that phenomenon on this memorable occasion. I copy from my daily journal without translating the French metrical numbers which I have for many years employed.

I add some hourly observations upon the perturbations of the magnetic current after the phenomenon, as well also as some observations on the subject at large.*

* In conformity with our design to give at present only facts, we reserve Father Cornette's ingenious speculations to another occasion.

Meteorological Observations at Springhill, lat. 30° 41′ N. *Elevation* 46 *metres*. (In French metrical and thermometrical standards.)

1859	Barometer (uncorrected.)					Attached thermom.		Detached thermom.			Wet bulb thermom.			Absorption.			Temp. wells.
Aug.	4h	9h	12h	3h	9h	Min.	Max	6	2	9	6	2	9	Int'r mm.	Ext'r mm.	woods.	
27	760·0	760·9	760·7	759·6	760·[illegible]	27°	30°	22°·6	30°·3	24°·4	21·8	23·0	22·7	1·5	6·0	....	
28	59·1	60·7	60·4	59·0	59·[illegible]	28	30	22·7	30·7	26·0	21·8	25·0	23·8	1·5	6·0	3·0	21·1
29	59·2	59·9	59·8	57·8	58·[illegible]	27	28	24·2	26·4	24·3	22·0	23·0	23·0	1·0	4·0	2·5	
30	758·5	58·6	....	57·2	58·[illegible]	27	29	21·2	26·6	22·8	19·2	22·1	20·7	1·2	5·0	....	21·1

	Wind.			Clouds.			Rain.			
	Morning.	Evening.	Night	Morning.	Evening.	Night.	Morning	Evening.	Night.	mm.
Aug. 27	C N	N^2	C	S	S	S	0	0	0	0·0
28	C $\frac{N}{S}$	$\frac{N}{S}$	C	S N :	*n*	*n*–S N–	0	0	R^N 0	0·0
29	NWsNW	NW	NW	N :	N–*n*,	*n* ;	*p p*	0	0	0·5
30	N	N	C	*n*, *n* :	*n*,	S.	0	0	0	0·0

Explanation of the notation.

1st. *For the winds.*—C calm. N^2 north wind of the 2d order, 5 being a gale.
$\frac{N}{S}$ north over a south wind, or opposite winds as shown by clouds.

2d. *For the face of the sky.*—S serene. N cloudy. *n*, slight cirrus clouds.
n : nebulous clouds. N– slight stratus clouds.

3d. *For rain storms.*—*p* rain. R^N heat lightning to the north. T storm.

Magnetic Declination (relative diurnal).

1859.	4h	6h	9h	12h	3h	6h	9h
Aug. 27	23′, 29″·5	......	34′, 56″·5	......	26′, 40″·5	23′, 29″·5	22′, 10″·0
28	34′, 56″·5	......	47′, 59″·0	......	29′, 50″·0	41′, 59″·0	66′, 54″·3
29	61′, 47″·5	47′, 6″·0	36′, 14″·0	40′, 0″·5	37′, 34″·0	30′, 50″·0	37′, 34″·0
30	36′, 15″·0	......	28′, 7″·0	......	25′, 59″·0	....	31′, 7″·0

In the night of August 28, *after the Aurora Borealis.*

Hours.	Decl'n.	Barom.	Therm.	Psych't	Hours.	Declin'n.	Barom.	Therm.	Psych't	Sky.
h. ′	′ ″					′ ″				
9 10	82 52·0	759·0	....	....	9 37	56 39·0	759·2	...	...	
15	76 29·0	....	25·8	23·8	50	64 21·0	....	...	...	
20	71 22·0	759·1	....	....	10 0	65 39·0	....	...	...	
25	58 39·5	....	....	....	10 10	61 47·5	759·4	25·0	24·1	S
29	50 17·5	....	....	....	4 A. M.	61 47·5	....	25·5	23·4	N–
9 34	55 25·0	....	....	....	5 A. M.	32 24·0	....	25·0	22·2	N :

In order to a full understanding of these tables it would be requisite to know also the whole course, absolute and relative, of the various atmospheric phenomena. This would be too long an undertaking, although the means are at command. But from the observations of the four days mentioned, we are able to draw the following conclusions:

1st. The density of the air shows an unusual course. The barometer daily rises, as we know, under the equator (and at Springhill), from four to nine o'clock in the morning, and from four until nine in the evening, and it falls regularly in the intermediate hours. During six years I have scarcely found a single

exception to this law between the equator and Mexico, and the exceptions are very rare at Springhill. Such an exception happened on the night of the Aurora Borealis (Aug. 28) when the barometer remained stationary from three to nine, and rose after nine when it should have fallen.

2d. The temperature fell considerably but not until the next day (29th) under a northwest wind, which had not blown for a long time, and which is ordinarily cold.

3d. The tension of watery vapor in the air was slightly modified. The mean degree of saturation on the 27th and 28th was 21°·35, tension 18·7^{mm}; 29th and 30th was 22°·40, tension 19·9. The 28th at 9 in the evening during the phenomena 22°·26, tension 19·7; 28th at 10 in the evening after the phenomena 23°·47, tension 21·2^{mm}.

4th. The absorption of water by the atmosphere either in an open vase, upon the belvidere of the college, in a room, or in the forest, was considerably more before than after the phenomena.

5th. On the 28th of August there were two diametrically opposite winds. The south, on the earth, and the north, in the upper regions, driving the cirrus clouds to the southward. The 29th the northwest wind prevailed, lowering the barometer.

Without doubt this opposition of winds is due to some extraordinary phenomenon, by which the atmospheric equilibrium was destroyed. I have been able both here and under another sky, to recognize that there is some intimate relation not only between the struggle of the winds and the course of the magnetic currents, but also (the discussion of which is out of place here) to reach an induction in explanation of earthquakes. That fearful phenomenon which I have felt and observed seventy-three times, has always occurred during a calm following a struggle of winds.

6th. Before the Aurora Borealis cirrus clouds (frequently caused by contrary winds) prevailed.

7th. The magnetic declination is the essential point which demands our attention: declination relative, hourly or daily. The normal daily course of the magnetic needle in the northern hemisphere is well known, viz., it moves to the east from four o'clock in the morning till near eleven, and from three till near ten in the evening, and returns to the west in the intermediate hours. In the southern hemisphere the course is opposite.

Near the equator the course is regular and the amplitude restricted. In high latitudes it is more disturbed and the amplitude larger. Three years observations in 4°, 14°, and 19° north latitude, leaving me no doubt upon the accuracy of these maxima and minima. In these latitudes this daily march was disturbed only during earthquakes, and returned to its normal order after the quaking. At Springhill (where I have followed

its daily course five times and even eight times a day according to my occupations, since June, 1858) it has had a regular course depending on the wind from the end of September (1858) until the 17th of August last. In short, from August and in September it has experienced great perturbations which I was tempted to attribute to the influence of the comet of last fall. But the Aurora of August has destroyed my conjectures and cast a new light upon this mystery. Since the 17th of last month (Aug.) the normal course of diurnal declination was scarcely recognizable and consequently I have followed it with the more interest. This disordered movement reached its maximum of observed perturbation at 9 o'clock 10 minutes in the evening of the 28th of August immediately after the auroral phenomena, and its course has since become as irregular as before. The perturbations were finished near 4 o'clock in the morning of the 29th, and last evening (September 1st) the declination had gradually diminished.

By the tables at the opening of this communication we see that the easterly declination between 3 in the evening and $9^{h}\cdot10$ in the night was $58' 2''\cdot0$. This is the first occasion I have been able to seize upon so considerable an anomaly in so short time. The needle subsequently made two new oscillations up to 10 o'clock 10 min., when I retired.

This morning at 4 the needle had attained another considerable maximum. I ran to the window in time to see the conclusion of another Aurora Borealis. The Aurora of the evening lasted, I understand, until near 3 o'clock, and with a light as brilliant as that of the moon, but without luminous rays, neither was there much diffused purple light. The same cause had produced the same effect, since that moment, (which does not coincide exactly with its maximum) the declination has decreased gradually. The Aurora to-day descended quite to the horizon; it appeared as a little cloud at the northeast and was dissipated at 4 o'clock 30 minutes A. M.

The purple light extended from the north on the night of the 28th of August at an angle of 80°, accompanied by thin sheafs of white light which shot up for a moment from the magnetic pole to the height of *Polaris* (30° 41′).

If observers in different latitudes could have established the conclusion that the opposed aerial movement reigned simultaneously in the atmosphere and developed in the air electric tension, that a calm followed the struggle, and that the Aurora Borealis happened during a calm, they would have made a glorious conquest for science.

But these facts remain yet to be observed. No Aurora Borealis appeared to me in the equinoctial regions as far as lat. 20° from 1847 to 1857. The first which I saw—at Troy, N. Y.,

July 25th, 1857—took place after a rain storm and above a low characteristic cloud during a calm which followed a contest between a south and southeast wind. It was less brilliant than that of August 28th.

The Aurora of August 28th took place in a calm after a struggle between two opposite winds, and that of to-day took place in the calm after a day in which the north wind prevailed in the morning and the south in the evening, but the clouds were immovable and induced the belief that the south wind was low, and that the north wind had ceased.

The Aurora Borealis of the 28th appears to authorize the inference that the light diverged from the magnetic pole, or that it was produced by a radiation of the polar magnetism from the terrestrial magnet. The most brilliant rays which escaped, emanated rapidly from a center below the horizon and that center was in the direction of the magnetic pole. A simple plumb line showed that the rays which reached *Polaris* were not perpendicular beneath that star but were inclined to the east some degrees.

Now the magnetic pole at Springhill is at 6° 28′ east, (mean from several observations). The other inclined rays might have served to determine the place of this center had time permitted my arranging an instrument for taking their sine.*

The low clouds frequently characteristic of the Aurora Borealis did not appear with those of last night. On the 28th there was an expanded and regular stratus in the horizon even to the height of about 8°, with heat lightning from time to time from the northwest.

7. *Observations at Jefferson Co., Miss.* (about lat. 31° 50′, lon. 91°), by an anonymous correspondent—published September 9th in the Port Gibson Reveille.

The Aurora Borealis of Sept. 1, 1859.—My attention was attracted at 11 o'clock last night, (Sept. 1st) to this rare but beautiful celestial phenomenon.

A belt of white light tinged with pink shot up from the northern horizon to the height of twenty or twenty-five degrees and extended east and west nearly the same elevation. Looking to those points I noticed the color deepening until about N.E. and N.W. it attained a bright deep scarlet red, like deeply tinged clouds of our dry-weather sunsets. It shot up in irregular columns arising in places almost to the zenith and spreading out fan shaped and paling as it rose. The white light was stationary except apparently sinking lower or rising higher. The colored

* It was equally impossible to prove that the rays change their direction at the same time that the magnetic needle changes its direction.

portions evolved, rolled, curled, and changed place and color, like the vapors climbing a mountain side. There was a very light surface breeze from the N.N.E. but the tendency of the meteor was to S.S.E. At half-past twelve, it embraced almost the entire northern hemisphere west, and at the height of from 45 to 60 degrees, a broad scarlet belt pointing S.W. to N.E. appeared, 80 degrees long and half as wide, having a dozen bright bars running longitudinally from end to end. It presented every color of the rainbow except blue. At the same time a brownish red column shot up from the N.E. resembling the flame of a huge lamp or candle, vibrating and flickering as though disturbed by wind. No sound was heard.

At 1 o'clock A. M., the white light under and to the left of the polar star was as bright as twilight half an hour before sunrise of a fair morning and extended almost to the zenith. I could see every object in the rooms—the hands of a clock and watch—out of doors the earth had a reddish glare, and every thing was as visible as at half moon, but more distinct as no shadows were cast.

In the white portions the stars were dim but in the colored parts east, west, and overhead were very bright but reddish, like the planet *Mars*. *Aldebaran*, the *Pleiades*, *Orion* and the two dog stars rose during the time and were unusually brilliant. The southern hemisphere looked dark and gloomy from contrast, but was without a cloud. All around the northern horizon there was a thin narrow belt, barely reaching the tree tops of cirro-stratus clouds. The lights were evidently beyond these. I counted seven meteors shooting athwart the heavens, from S.W. to N.E. during the two and a half hours I was up, similar to those of the great meteoric shower of November 13th, 1833, and such as may be seen any fair night between the 10th of August and 1st of December.

We witnessed an Aurora the early part of October 1851, large and brilliant for this latitude, but in no ways comparable to the one of last night. The succeeding winter was long and unusually cold. SENEX, SR.

Jefferson Co., Miss., Sept. 2d, 1859.

8. *Description of two magnificent Auroræ Boreales observed at Havana, Cuba.* (In a letter from M. ANDRAS POEY, Director of the Physio-Meteorological Observatory at Havana, Sept. 8th, to the Editors.)

The appearance of the Aurora Borealis in the twenty-third degree of north latitude is an event so rare that it naturally produces fear in the common mind, and arrests the attention of men of science. The records and traditions of Cuba show but few examples of the occurrence of this phenomenon. The *first* is

said to have been seen on the 13th of November, 1784; the *second* upon the 14th of November, 1789; the *third* in 1833 (Nov.?); the *fourth* on the 17th of November, 1848; and finally the *fifth* and *sixth* now recorded.

First aurora on the night of Aug. 28th–29th, 1859.—The first appearance of a reddish gleam was seen at 5 minutes past 9 in the evening, which rapidly rose exactly in the north and extended over the space embraced between the N.E. and N.W., reaching the height of *Polaris* about 23°. Some persons, it is said, saw it as early as $8^h\ 45^m$. Its color grew brighter until $9^h\ 30^m$, but from this time it faded to its total disappearance at 10^h. A slightly luminous and whitish tint afterwards covered this part of the sky. But at 1 o'clock it reappeared, reaching again to *Polaris*. It attained its maximum brilliancy at 4^h to $4^h\ 10^m$—its base being of a beautiful carmine red, from which rose divergent rays of a variable diameter, some fire-colored, others whitish, and rising to the zenith, the reddish tint covering a space of 180° from N.E. to N.W. At $4^h\ 20^m$ the aurora disappeared entirely.

Second Aurora on the night of the 1*st*–2*d of September*.—This second Aurora having been incomparably more brilliant, more extended, and more permanent than the first, it seems best to notice the details of its development with care, as points of comparison with observations in higher latitudes. This aurora was not visible before $12^h\ 30^m$, and from that moment to 5^h A. M. I followed all its changes. From $12^h\ 30^m$ to $12^h\ 45^m$ it spread towards the east, and afterwards towards the west, then turning yet more towards the east with white rays which grew pale at the extreme west. From 12^h to 1^h after the white rays became extinct a portion of the east appeared of a beautiful fire-red. A part of the west became also more flaming, and the summit of the arch, poorly defined, attained the height of *Polaris*, with a movement of translation toward the east. At 1^h a brightness streamed from the north moving towards the N.N.E., defining by its light the outlines of cumulus clouds, of the horizon, of the sea, and the entrance of the fort. As this brilliancy increased and rose above the horizon its tints passed into light blue, involving the red portion at the northeast, and presently it began to fade out. The upper red segment rose considerably above *Polaris*. The illumination faded towards the northwest and embraced the whole of the auroral base; afterwards it rose again to the height of 12°. White rays with red and blue were then seen towards the west, which dilated longitudinally, oscillated laterally, were extinguished and resumed their brilliancy again by turns. The intensity of the illumination increased towards the east, and the red segment towards the west became more brilliant and more extended, until at the E.N.E. it

ached its maximum of brilliancy. At 1^h 15^m these rays were
read over the whole Aurora. The illumination attained to the
N.E. in the space of three minutes, then it extended to the
N.W. The east and still more the west then became very
d. The illumination reappeared next at the east. The whole
urora now became very red with rays to the north and west.
his shade spread almost to the zenith. The fire-red of the
est remained constant. The general depth of the Aurora faded
hile the whitish and reddish rays became more brilliant. But
was from 1^h 30^m to 3^h 15^m that the half hemisphere of the
orth from east to west was completely covered by a rich red
nt, more orange than carmine, the gently arched summit of
hich passed the zenith towards the northeast, attaining the
eight of 100 degrees, accompanied with whitish rays and also
ith the red rays, more vivid then the general tones of the seg-
ient rising to the zenith, yet without passing it. At 2^h the
urora had attained its highest magnificence. The heavens then
ppeared stained with blood and in a state of complete confla-
ration. At a vast distance above the upper red segment ap-
eared a second whitish segment which rose 23° above the hori-
on, while the upper red segment spread for 100° to the north-
ast and towards the constellation of Orion. The illumination
hose different phases I have followed then constituted a white
rch, the central and visible base of the Aurora above a bed of
umulus clouds which reached 8° above the horizon. At 2^h 45^m
he two segments or arches of the Aurora declining toward
he horizon, the lower white one first disappeared at 3^h 15^m A. M.
rom 3^h 30^m to 4^h the general reddish tint disappeared and re-
ppeared many times, but remained more intense towards the
ortheast. From 4^h to 5^h it gradually declined as the dawn
ommenced. At last the Aurora disappeared at 5^h A. M. in the
rolongation of the magnetic meridian where it made its first
ppearance. From 1^h the west was constantly more flame-col-
red than the east.

These two Auroras have manifested the following peculiarities
orthy of remark. 1st. The reappearance on the third night.
d. Their magnificence: in height considerably more than 100°,
n extent over 180°, their long continuance to day-dawn here
nder this latitude of 23°. 3d. The absence of an obscure lower
egment although it might readily have been covered with the
umulous clouds which rose 8° above the horizon: above all, the
xpanse of the Aurora, a segment the extent of which has not
een well established. 4th. The great height of 23° of the lu-
inous segment or lower white arch visible only in the second
urora. 5th. The rays or jets of light, some of which rose di-
erging from a point very far below the horizon, while others
pringing from the centre of the Aurora appeared to converge

slightly toward the zenith. Again they vanished for an instant to reappear over other points, some having a brilliant red, others a dense white mass with a feeble lateral pulsation and an alternate elongation and shortening. Sometimes the base of the rays was most brilliant and most deeply red colored, soon again the deepest and most brilliant color was on the upper extremities. 6th. The reiterated movement of translation of the whole aurora from east to west, followed by retrocession in an opposite direction, movements noted as being very rarely observed.

Space does not allow me to notice the concomitant phenomena which were produced, which from their importance will be the object of the next communication which I shall have the honor to address to the Academy. I enumerate the principal points observed. 1st. There was no noise in the aurora. 2d. The freely suspended needle of Marianini's Ré-Electrometer manifested not the slightest oscillation. 3d. The gold leaf electroscope of Bohnenberger gave no sign of atmospheric electricity. This neutrality of the magneto-electric force in the presence of so magnificent an Aurora Borealis is worthy of remark, for these two pieces of apparatus constructed by M. Ruhmkorff have great sensibility. 4th. There was no trace of polarization in the auroral light but very sensibly in its reflection upon the surface of the sea and upon the opposite clouds. 5th. It was perfectly calm. 6th. The temperature and barometric pressure were as usual. 7th. Two days after the Aurora the barometer rose from a half millimeter to one millimeter, following the height of the diurnal tide, and a northeast breeze set up.

9. *Observation at San Francisco, California;* by Dr. JOHN B. TRASK. (In a letter to the Editors, dated Sept. 1st, 1859.)

On the night of the 28th of August, at the hour of 10 o'clock, and continuing from that hour until near daylight we had for the first time in ten years in California a fine display of the Aurora. The sky was illuminated from the northwest to the northeast, with a flood of crimson light extending to the zenith, through which the whiter and yellow columns would start at varied intervals. It was a magnificent display and will compare favorably with the best varieties of your wintry months.

10. *Height of the base of the Auroral curtain, Aug.* 28.

The minimum altitude above the southern horizon of the lower margin of the meridional part of the auroral curtain, seen during the display of Aug. 28th, previous to 9 P.M., was determined independently by Prof. C. S. Lyman and by Mr. E. C. Herrick at New Haven, and by Prof. A. C. Twining at West Point, N. Y. These three determinations were made at about

the same absolute time (about $8^h 40^m$ New Haven time) and range from 10° 40′ to 12°. Fortunately, a like observation was made at Philadelphia, Pa., (N. lat. 39° 57′), by Mr. Chas. J. Allen, where and at Burlington, N. J. the display was observed by Mr. Allen and by Messrs. Benj. V. Marsh and Samuel J. Gummere. Mr. Allen found this minimum altitude at Philadelphia to be about 22½°. Assuming that the curtain was for a moderate distance parallel to the earth's surface, and that the observers saw the same curtain, it follows that the lower visible margin thereof was about forty miles above the earth. The probable error of this result seems to be quite small, yet it is highly desirable that the conclusion should be tested by observations taken at places between New Haven or West Point and Philadelphia and beyond, as far as Annapolis or Washington. The elevation of auroral belts observed in New England has been found to exceed one hundred miles, but the relation between auroral belts and streamers is little understood.

11. *Appeal to Observers.*

It is conceded that there is much connected with the auroral light which has not yet been fully explained, but it is unquestionably one of the most important of all meteorological phenomena, and its full explanation would probably bring with it the explanation of a large number of other phenomena, such as the origin and laws of atmospheric electricity, as well as of terrestrial magnetism. It is then of the highest importance to science that we should ascertain what the aurora is. The Aurora of Aug. 28th and following days affords a peculiarly favorable opportunity for deciding this question, and it is therefore important that this Aurora be thoroughly investigated. A thorough investigation of a single Aurora promises to do more for the promotion of science than an imperfect investigation of an indefinite number. It has been decided therefore to make a strenuous effort to investigate the laws of this auroral exhibition. For this purpose we need a careful collection of all the observed facts; and it is earnestly requested that every person who made accurate observations of the Aurora of Aug. 28th would communicate them to us for publication. This appeal is addressed to men of science in every part of North America where an Aurora was seen on the night of Aug. 28th. It is also addressed to observers on the ocean, and indeed throughout every portion of the globe, with the sole exception of Europe; for we assume that the appearances in Europe will be fully reported through the European journals. It is not improbable that this auroral exhibition may have been witnessed throughout the principal part of the northern hemisphere; and it is of great importance to know how far it did extend.

In order to render the communications of observers more definite and precise, we will briefly indicate the kind of information we desire.

We desire an accurate but concise description of all the phenomena with the *exact time* of their occurrence.

1. If a dark segment was seen resting either on the northern or southern horizon, or both of them, its altitude and position should be accurately stated.

2. If the streamers were seen to converge to a single point of the heavens, this point should be accurately located and the time of observation given.

3. If any single phenomenon (such as a detached luminous arch extending from the east to the west horizon) was so conspicuous as to be easily identified, it is important to have an accurate statement of its position and the altitude of its vertex, with the time of its formation and disappearance.

4. Was the Aurora seen in the southern half of the heavens, and how near the southern horizon did it extend?

5. Describe the color of the light, as well as its intensity.

6. If the Aurora exhibited any great variations of brilliancy it is important to know the times of least as well as the times of greatest brilliancy.

7. Did the Aurora exhibit any sudden flashes? Were there any pulsations like waves of light rushing up from the horizon?

8. If any observations were made showing the influence of the Aurora upon the magnetic needle, it is desirable that they should be communicated in detail.

9. The kind and degree of influence exerted upon telegraph wires.

10. Was any motion of translation observed in the Aurora, and if so, in what apparent direction and with what velocity?

It is proposed to publish in future numbers of this Journal, the most important part of whatever information may be obtained as the result of this appeal; and it is intended to present the facts in such a form that each one will have all the materials which are necessary to conduct the investigation for himself. After all the facts have been communicated, it is proposed to present an analysis of the whole, with some speculations on the general subject of Auroras. Observers may forward their communications either to the "Editors of the Journal of Science, New Haven, Ct.," or to "Prof. Elias Loomis, New York City," who has consented to undertake the discussion of the phenomena.

Postscript.—Any exact data, relating to the remarkable auroral arch of April 29, 1859—mentioned by Mr. Herrick on p. 154 of this volume, will *be very acceptable.*

ART. XLIII.—*Account of several Meteoric Stonès which fell in Harrison Co., Indiana, March 28th*, 1859; by J. LAWRENCE SMITH, M.D., Prof. Chemistry, University of Louisville, Ky.

HAVING become acquainted with a remarkable phenomenon accompanied with a fall of stones that occurred in Harrison Co., Indiana, I immediately made enquiries concerning it, expecting to visit the neighborhood on an early occasion; but I was fortunate enough to learn of some admirable observations made by Mr. E. S. Crosier, and in fact so complete were his examinations that I clearly saw that no additional information could be elicited by my resorting to the spot. Mr. Crosier obtained for me the various stones that had been found, and also put himself to much trouble to obtain the information desired.

The stones fell on Monday the 28th of March, 1859, and Mr. Crosier visited the place on the Saturday following; in the mean time the following stones were discovered:

No. 1,	weighing	19 oz.,	discovered by	Goldsmith.
2,	"	4¼ oz.,	" "	Crawford.
3,	"	420 grains,	" "	Lamb.
4,	"	167 "	" "	Mrs. Kelly.

The following are the facts elicited by enquiry on the spot.

The time at which it occurred (4 o'clock in the afternoon) rendered the phenomenon of ready observation. The area of observation was about four miles square, and wherever persons were about in that area, the stones were heard hissing in the air, and then striking on the ground or among the trees.

Hardly a single person in the immediate vicinity of the occurrence saw any flash or blaze as was noticed by all who heard the report from a distance.

Three or four loud reports, like the bursting of bombshells, were the first intimations of anything unusual. A number of smaller reports followed, resembling the bursting of stones in a lime kiln. The stones were seen to fall after the first four loud explosions. Those who happened to be in the woods or near them heard the stones distinctly striking amongst the trees. In some places the noise of the falling stones in the woods alarmed the cattle and horses in the vicinity, so that they fled in terror. A peculiar hissing noise during the fall of the stones, was clearly heard for miles around. A very intelligent lady described it as very much like the sound produced by pouring water upon hot stones. The air seemed as if all at once it had become filled with thousands of serpents.

Mr. Crawford and his wife were standing in their yard at the time, and hearing a loud hissing sound overhead, on looking up

a stone (No. 2) was seen to fall just before them, burying itself four inches in the ground, they dug it up immediately, but it did not possess any warmth; it had a sulphurous smell. Another which they did not find fell near them, when they thought it prudent to retire to the house.

Two sons of John Lamb were in the barn yard attending to the horses, when their attention was called to a loud hissing noise above, and immedialely a stone (No. 3) fell just at their feet, penetrating the hard tramped earth some three or four inches, and they state that it was warm when taken from the ground. Another fell in a peach tree near by, but the ground being newly plowed they were unable to find it.

The largest stone (No. 1) was not obtained until the following day, being dug up beside a horse track on the streets of Beuna Vista, Indiana, it having penetrated the hard gravel to the depth of four or five inches. It had a strong smell of sulphur. The last (No. 4) was dug up by Mrs. Kelly the following day in her yard.

These four aërolites, owing to their being buried deeply in the ground, are all that have been found up to this time. None have been found or were heard to fall over a greater area than four miles square.

These are all the details that I have been able to gather connected with this fall of meteoric stones. They are highly interesting and probably as accurate as it is possible to obtain.

Nos. 1, 2 and 3 and a fragment of No. 4 were placed in my hands for examination. Nos. 1, 2 and 4 are cuboidal in shape, No. 3 was considerably elongated; they are all covered by a very black vitrified surface, equally intense on every one and on every part of each one, and when broken show the usual grey color of stony meteorites interspersed with bright metallic particles.

The mean specific gravity is 3·465; when broken up and examined under a glass four substances are distinguishable: metallic particles, dark glassy mineral, dark dull mineral, white mineral matter.

Examined as a whole the following elements were found in it: iron, nickel, cobalt, copper, phosphorus, sulphur, silicium, calcium, aluminum, magnesium, manganese, sodium, potassium, oxygen.

By the action of the magnet it was separated into

Nickeliferous iron, - - - - - - - -	4·91
Earthy minerals, - - - - - - - -	95·19
	100·00

The earthy minerals acted on by warm dilute hydrochloric acid, thrown on a filter and thoroughly washed, then treated

with dilute caustic potash, to dissolve any silica of the decomposed portion that was not dissolved by the acid, gave

Soluble portion,	62·49
Insoluble portion,	37·51

The metallic portion separated from the earthy part gave

Iron,	86·781
Nickel,	13·241
Cobalt,	0·342
Copper,	0·036
Phosphorus,	0·026
Sulphur,	0·022

The earthy portion freed from metal gave

Silica,	47·06
Oxyd iron,	26·05
Magnesia,	27·61
Alumina,	2·35
Lime,	0·81
Soda,	00·42
Potash,	00·68
Peroxyd manganese,	trace, not estimated.

It is clear from the analyses as made out, that these meteoric stones contain the constituents frequently found in similar bodies, namely: nickeliferous iron, phosphuret of iron and nickel, sulphuret of iron, olivine, pyroxene and albite; and in about the following proportions.

Nickeliferous iron,	4·989
Schreibersite,	·009
Magnetic pyrites,	·001
Olivine,	61·000
Pyroxene and albite,	34·000

I have no intention to enter into any speculations in relation to these meteoric stones, although I have accumulated some additional matter on the subject since my memoir on meteorites published in the Am. Jour. Science, vol xix, pp. 152 and 322, intending to reserve their publication for a future occasion.

Louisville, Ky., Oct. 1, 1859.

ART. XLIV.—*Geographical Notices.* No. IX.

THE INLAND SEAS OF AFRICA. SOURCES OF THE NILE.—The Royal Geographical Society of London have awarded the Founder's Medal for the current year to Capt. R. F. Burton, of the Bombay army, for the discovery of the great lake of Tanganyika, in Africa, the more northern lake being discovered by his coadjutor, Captain Speke. The journeys of these bold explorers have been previously mentioned in this Journal. On June 26, 1857, the two travellers left Zanzibar for the interior

and succeeded in reaching the great lake Tanganyika, 300 miles long, and 30 broad, which lies about 700 miles from the coast. Captain Speke proceeded from Unyanyembé to another vast inland lake called Nyanza, the south end of which was fixed by him at 2° 30′ S. lat., and 33° 30′ E. long. It is estimated to have a width of about 90 miles, and is said to extend northward for upwards of 300 miles.

Sir Roderick I. Murchison, President of the Royal Geographical Society of London, in his annual address gives the following account of the discoveries of Burton and Speke which are particularly important in reference to the long disputed problem of the Sources of the Nile.

"Returning to Europe from Aden, both Captains Burton and Speke sought and obtained employment in the Turkish contingent of the allied armies operating in the Crimea. Thrown out of their military career by the peace, they returned to the east coast of Africa, with the view of exploring the country from the coast of Zanzibar as far inland as might enable them to ascertain the real geography of the interior in that latitude.

"Aided by the late Colonel Hamerton, our meritorious consul at Zanzibar, and by Seyd Majid, the second son of the Imaum of Muscat, now the Prince of Zanzibar, the travellers made an experimental journey from that place on the coast to Fuga in the mountain country of Usambara. In their last and great expedition they again proceeded from Zanzibar. Their party consisted of twelve Belooches furnished by the kindness of the Sultan, some negroes who had been slaves, and asses for the transport of goods and for riding. Passing over the delta and low hilly country called M'rima, they entered the mountainous coast range at about 120 miles from the coast. This range which rises to a maximum altitude of 6,000 feet, with a width of about 90 miles, is chiefly composed of sandstone and crystalline rocks, the true character of which will be ascertained when Captain Burton's specimens arrive.

"Descending from the coast range to the great interior plateau land, at a lower level, and travelling over some poor lands, they reached a rich country in which knolls or bosses of granite and basalt rise up like rocks in an ocean. The country is exclusively peopled by negroes, none of whom are Mahomedans, as are the Somaulis and trading Arabs of the coast.

"Like the Negroes described by Livingstone, they have no special religion, trusting solely to good and evil spirits. Such of them as have sultans are on the whole peaceable, fire-arms being rare among them. Their country produces cotton, tobacco, maize, sweet potatoes, a great variety of pulses, manioc, yams, plantains, and melons; they manufacture iron, cotton fabrics, have abundance of cows and goats, and live in comparative comfort.

"From Kazé, in Unyanyembé, a spot where the Arab traders have established a sort of mart, and where articles from the coast are bartered for ivory and slaves, the travellers moved westerly until they reached the long inland mass of water trending from S. to N., which has been styled Uniamesi and Ujiji, but the real name of which is Tanganyika.

"This lake was found to be 1,800 feet only above the sea, or about half the average height of the plateau land west of the coast range. It has a length of about 300 and a breadth of from 30 to 40 miles.

"This great internal mass of water was determined to be an insulated depression into which streams flow on all sides. It was crossed by Speke in the centre, and navigated conjointly with Burton to near its northern end, where it is subtended by mountains which were estimated to have a height of from 6,000 to 7,000 feet within the range of the eye.* Its waters are perfectly *fresh* and peculiarly agreeable to drink, and it abounds in delicious fish, whilst its banks are grazed by red oxen of large size, some of them having stupendously long horns. Oxen are indeed common over nearly all the region examined, for the *tsetse fly*, the scourge of the more southern African countries, in which Livingstone travelled, is unknown.

"A singular phenomenon of blindness affected for some time both the travellers. Whilst exposed in the arid, hilly coast range, and also in the plateau land, to a fierce and glaring sun, their sight was unaffected; but on descending into the verdant, well watered, and rich lacustrine expanse of Tanganyika their sight was dimmed, and gradually they became almost blind—their recovery being slow and imperfect. It was this calamity alone which diminished the number of astronomical observations made by Captain Speke, who lost no opportunity of fixing the latitude and longitude of numerous positions.

"When returned to their chief central station in Unyanyembé, Speke, thriving upon hard field work, left his invalid companion

* Since this Address was delivered, the British Museum has acquired a curious, large, old Portugese MS. map of the world, on the Mercator's projection, made by Antonio Sances, in 1623, which shows how much general knowledge of the interior of Africa was possessed at that period by the Portugese. On this vellum map, the author distinctly places one large body of water in the centre of Africa, and in the parallel of Zanzibar. Although all the details are inaccurate, and he makes the Congo flow out of this lake to the west, and another river (representing probably the Zambesi), which is called R. de St. Yurzes, from the same to the S.E., still the general notion of great internal waters is there put forth.

Chevalier Pertz has recently discovered in an old MS. in the Royal Library at Berlin that, even in the year 1291, two Genoese navigators, Teodosio Doria and Ugolino Vivaldi, sailed for a certain distance down the West Coast of Africa. Their ships were called *Sant' Antonia* and *Allegranza*, and the last-mentioned name has, indeed, remained attached to the most northern of the Canary Islands. It has been erroneously stated in some journals that these Genoese navigators sailed round the Cape of Good Hope.—*June* 20, 1859.

in order to reach the great lake Nyanza, the position of which had been pointed out to him by the Arabs, who asserted that it was much longer and larger than Tanganyika, from which it is separated by about 200 miles. In this journey Captain Speke, accompanied by his faithful Belooches, passed through the district where the chief iron works of the country are carried on; the native blacksmiths smelting the ore with charcoal.

The great lake Nyanza was found to occupy the position assigned to it by the Arabs, and the E. longitude being very nearly that of Kazé, viz., 32° 47′,* its southern end was fixed at 2° 30′ S. lat. Ascending a hill and looking northwards, the enterprising traveller could discern nothing beyond the islands termed Ukerewe, but a vast interior sheet of water, which, according to those Arabs, whose information had hitherto proved correct, extended northwards for upwards of 300 miles. Captain Speke, who estimates the breadth of this internal sea at 90 miles near its southern end, further ascertained that it is fed not only by streams flowing from the mountains which separate it from Lake Tanganyika, but also by other streams, many of which meandering in the lower plateau to the west of the lake, constitute, like the internal rivers described by Livingstone, a watery network which when supersaturated by the rains burst and overflow the country.

"Seeing that this vast sheet of water extends due northwards, ascertaining by his thermometer that it was nearly 4,000 feet above the sea, and knowing that its meridian was nearly that of the main course of the White Nile, Captain Speke naturally concludes that his Nyanza is the chief source of that mighty stream on the origin of which speculation has been so rife. This view seems to coincide with the theoretical speculation laid before this Society by myself in preceding years, and is in accordance with the data worked out by Livingstone, of a great interior watery plateau subtended on its flanks by higher lands, and from which interior plateau the waters escape to the sea by favoring depressions.

"The physical configuration of the land to the east of the great Nyanza Lake is indeed strongly in favor of this view. On that side, and at a distance of about 200 miles from its banks, the eastern coast range of Africa rises from 6000 feet in the latitude of Zanzibar (where it was passed by our travellers) into a lofty range or cluster, of which Kilimanjaro forms the southern and Kenia a northern peak.

"If the assertion of Rebmann and Krapf be accepted, that perpetual snow lies on those mountains, though the able critical essay of Cooley† had induced me to suppose that these mission-

* Lunar observations were made at this station.

† *See* Cooley's "Inner Africa Laid Open," p. 126.

ries might have been somewhat misled, the summits of these nountains must have an altitude of upwards of 18,000 feet. At ll events it is granted that they are the highest points of this oast range. Now, whilst streams descending from the western ank of Kenia (Kilimanjaro is too far to the south) may probaly be feeders of the great Nyanza Lake, which occupies a long ateral north and south depression in the plateau on the west, we now from its meridian as now fixed, that the direction of this resh-water sea points directly to Garbo, the spot in latitude 3° orth reached by M. Ulivi, as related by Brun-Rollet, a Sardinan, who had established a trading post at Belenia in latitude 4° 0′ north, on the White Nile in 1851. The north and south irection of the Nyanza, which Speke believes to reach from outh latitude 2½° to 3° 30′ north latitude, brings us in fact beond the Garbo of Ulivi and Brun-Rollet.*

"The variations which occur in the height of the waters at ifferent seasons, in the interior plateau-country surrounding the reat lake, were strikingly described to Captain Speke by the Arabs, when they assured him that at one season of the year the vater lilies were so abundant as to enable the traveller to pass ver a wide river by treading on their broad and thick floating eaves, showing how flat the country must be, and how sluggish re the streams.

"Let us hope that when re-invigorated by a year's rest, the ndaunted Speke may receive every encouragement to proceed rom Zanzibar to his old station, and thence carry out to demontration the view which he now maintains, that the Lake Nyanza s the main source of the Nile. Considering the vast difficulties vhich beset the traveller who attempts to penetrate southwards y ascending the Nile, it seems to be preferable that the effort hould be made from Zanzibar, where Captain Speke is sure of eing heartily supported by the Sultan, and whence, taking men n whom he could rely, he can certainly calculate on reaching he Lake Nyanza in good plight, for that zone of Africa which e has passed through is now ascertained to be occupied by a nuch more tranquil people than those of the countries north and outh of it.

"On former occasions I contended that the periodical overflow f the waters from the internal fresh-water lakes was explicable y the fact, that at certain periods of the year, differing of course n different latitudes, the rain-fall of several months would at last o supersaturate the interior plateau-lands and lakes as to pro-uce periodical annual discharges. That the lofty mountains of

* M. Jonard has analyzed and compared the discoveries of M. Brun-Rollet, who ives some information derived from De Angelis, who resided at Belenia in 1851, hich is worthy of attention. But speculations founded on such uncertain data are f no great value.

the coast range, of which Kenia is the chief peak, may throw off certain feeders of the White Nile, just as the mountains of Abyssinia feed the Blue Nile, must probably be the case; but whilst it may be admitted that little snow may occupy the peaks or summits of Kilimanjaro and Kenia, I am of opinion with the learned Cooley* that the elevation and mass of these mountains are not such as would sustain a vast range of snow and ice, the melting of which would account for the annual rise of the Nile. Even if it be assumed that this is really a snowy chain, the exact periodical rise of the Nile could never be caused by a periodical melting of its snows, since the power of the sun under the Equator is so nearly equable throughout the year, that it must operate in filling the streams which descend from the mountains with pretty much the same amount of water at all seasons. The great phenomenon of the periodic rise of the Nile is, it seems to me, much more satisfactorily explained by the annual overflow of a vast interior watery plateau, which is, thanks to Captain Speke, ascertained to have an altitude much more than adequate to carry the stream down to Khartum, where the Nile is believed to flow at a height of less than 1500 feet above the sea; and as the river below that point passes through an arid country, and is fed by no lateral streams, it is to the southern, central, and well-watered regions that we must look for the periodic supply.

"On consulting Captain Speke respecting the rainy season of that part of the interior of Africa which lies between Ujiji and Unyanyembé, I find that in about east longitude 30° and south latitude 5° the rains commence on the 15th November and end on the 15th May, during which period of six months they fall in an almost continuous downpour. Farther northward, where the Lake Nyanza lies, the rainy season, in the common order of events, would commence, he supposes, somewhat later, and probably at a time which will account for the periodical rise of the Nile at Cairo on the 18th June. In support of this view Captain Speke states that the river Malagarazi, which drains the surplus waters from the southeast slope of the mountains between the Lakes Nyanza and Tanganyika, when first crossed by the expedition, was within its banks, but on the 5th June it had quite overflowed them and constituted a stream 100 yards broad, run-

* This acute scholar has shown his power as a comparative geographer by a close analysis of the *quæstio vexata* respecting the Nile of the ancients, and shows that the true Nile of Ptolemy was the Blue Nile, which descends from the mountains of Abyssinia. He also shows that the great lakes of the Nile of Ptolemy are at the Equator—a view now confirmed by the researches of Speke. As to Kilimanjaro, he says it is "an insulated mountain in a sea-like plain, and on a fifth scale of the magnitude required for maintaining perpetual snow near the Equator." *See* also his work "Inner Africa Laid Open," in which he explains the existence of a great sea or lake in the interior of Eastern Africa.

; westwards into the depressed lake of Tanganyika. Now, ccording to the Arabs, and other intelligent men with whom onversed, the whole region to the northward of the mountain uestion, *i. e.* beneath and to the north of the Equator, is an nsive marshy plateau, intersected by some large and innu- able smaller streams, all feeders of Lake Nyanza, we have · to suppose that at the *close* of the rainy season the great harge occurs, and we then have in these data strong grounds elieving, that the theory which I ventured to propound to Society as the best explanation of the overflow of the ibesi of Livingstone, as well as of the Congo and other Afri- rivers, will also be found to be applicable to the Nile.

In concluding this notice of the labors destined to clear up problem of the real sources of the Nile, I must express my iks to Mr. M'Queen for his efforts to collate all the data con- ing the ascents of the White Nile from the expedition sent Mahomed Ali in 1839 to that of Don Angelis, which Brun- et accompanied in 1851, and when the party reached 3° 50′ h latitude, 31° east longitude. Adding to information ob- ed from natives and Arabs, and citing Lucan and other ent authors to the same effect, Mr. M'Queen contends that a ' mountain to the southeast of the cataracts of Garbo, the station of Brun-Rollett and his companions, which must be ia, is the chief feeder of the White Nile, and that the river esi, spoken of by the African King of Bari, is really the ibiri heard of by Dr. Krapf.

Now, even if this view be sustained, it seems to me to be e compatible with the fresh knowledge obtained by Captain ce, and his inference, that the Nyanza is the chief feeder of White Nile. For the southern extremity of this great id lake is but 2½° south of the equator, whilst its western e is probably not more than 150 miles from the lofty moun- of Kenia. Hence, seeing that Nyanza is about 4000 feet · above the sea, and that the eastern mountains, under the itor, are much higher, there is every probability that this sheet of water may be fed from the east by streams flowing ı Kenia, as it is ascertained to be supplied from the south- ; and west by other rivers flowing from the mountains, which rate this high sheet of water from the depressed Lake ganyika.*

If then it should eventually be proved, that the Lake Ny- contributes its annual surplus waters to the White Nile, so

Mr. Edw. Heneage informs me that Botero, in his "Relationi Universali" ice, 1640), says that the eastern Nile flows out of a lake 220 miles long, situa- nder the equator; and he places the sources of the western branch of that S. lat. 9°, close to the sources of the Zaire or Congo, and what may also be led for the origin of the Zambesi.

may it then be fairly considered as the main source of the great river; the more so when we see that its southern end is farther to the south, or more remote from the embouchure, than any other portion of the Nilotic water-parting.* On the other hand, the high mountains which flank the great stream on the east, and probably supply it with some of its waters, may by other geographers be rather viewed as the main and original source. These are the only remaining portions of the great problem which have to be worked out—a problem which it has been the desideratum of all ages to unravel, and one which, according to Lucan, made Julius Cæsar exclaim, that to gain this knowledge he would even abandon the civil war†—a problem which Nero sent his centurions to determine, and which, by the last discovery of Captain Speke, seems certainly now to approach nearly to a satisfactory solution."

WARREN'S MEMOIR TO ACCOMPANY A MAP OF THE WESTERN TERRITORY OF U. S.—We have already referred to the admirable map by Lieut. G. K. Warren, U. S. Topog. Eng., prepared to illustrate the result of the various expeditions of the government to the teritory west of the Mississippi river.‡ We have now received a volume from the pen of the same officer, illustrative of the map. It is printed from the advance sheets of the eleventh volume of the Pacific Rail Road Surveys. This memoir is not limited to a description of the map, and an account of its method of compilation. It gives in a condensed form a review of all the exploring expeditions in the West since 1800.

The first period extends from 1800 to 1832, beginning with the travels of Lewis and Clarke and concluding with those of Hardy, Ross Cox, Allen, and Schoolcraft.

The second period, from 1832 to 1844, includes the exploration of Bonneville, the early discoveries in Great Salt basin, Nicollet's hydrographical survey of the upper Mississippi, the beginning of Frémont's travels, and other reports and maps of army officers, the topographical engineers.

The third chapter is devoted to more than twenty expeditions, of greater or less importance undertaken between 1843 and 1852, almost exclusively under the patronage of the U. S. Government.

* Although both White Nile and Blue Nile are fed by many affluents, the remarkable physical feature of the great stream below their junction is that in a course of 1200 miles it is not increased by the addition of any lateral waters. On this feature, as well as on the parallelism of its course to the great N. and S. depression of the Red Sea, on the fertilizing powers of its waters, and on the periodicity of its flood, the reader will do well to consult the article "Mediterranean Sea," Edinburgh Review, vol. cvi., which is from the pen of our accomplished associate Sir Henry Holland.

† "Spes sit mihi certa videndi
Niliacos fontes bellum civile relinquam."—LUCAN, *Book* 10.
(As quoted by Mr. M'Queen.)

‡ This Journal, vol. xxvii, 286, 1859.

In 1852, the various important Surveys for the Pacific Rail Road commenced, and a review is given of their several routes and objects. To this historical report, succeeds a statement of the method of completing the general map before alluded to and some remarks on the topography of the region west of the Mississippi River.

Four reduced copies of early maps of the territory west of the Mississippi are included in the Memoir; first, of a map published with Winterbotham's History in 1796; second, of Rector and Roberdeau's map, 1818; third, a part of Finley's North America, 1826; and finally, of Bonneville's map which appeared in 1837.

The Memoir and the Map taken together are an important accession to our knowledge of the physical geography of this continent and will be of constant service not only to men of science, but to statesmen and all others who are interested in the structure and resources of the immense territory which lies to the west of the Mississippi river. In this connection, we may call attention to the tenth volume of the surveys of the Pacific Rail Road which has just been distributed, containing Part III. of the report on "Zoology," prepared by Prof. Spencer F. Baird of the Smithsonian Institution.

History of the Discovery of America. Atlas of Kunstmann, Spruner and Thomas.—In striking contrast with the work we have noticed by Lieut. Warren and its illustrations of recent discovery, we may mention the republication of early maps of this continent (chiefly the Atlantic coast,) which has been just made under the auspices of the Bavarian government. A few copies of this truly magnificent atlas have been received by Messrs. B. Westermann & Co., in New York. In place of comment of our own, we translate from the Berlin *Zeitschrift für allgemeine Erdkunde*, the following condensation of the plan of the compilers.

F. Kunstmann, K. v. Spruner and G. M. Thomas have published an Atlas on the history of the discovery of America, which consists of thirteen most interesting sheets printed in fac-simile from those most valuable chartographical documents, which are found in the Royal Library, the Library of the University and the Military Conservatory at Munich. F. Kunstmann in his learned treatise "Die Entdeckung Amerika's, which precedes the text explanatory to the charts, says, "The charts commence in the 14th century, when they first appear as the product of independent inquiry, and follow the progress of the voyages of discovery, the results of which are for the most part deposited in them. Our knowledge that the Azores were discovered in the 14th century, we owe solely to the charts, as we have no other historical accounts concerning them. The history of the Canary Isles which is at first but fragmentary, is also completed by them.

They also enlighten and increase our knowledge in relation to the discoveries in America generally. In these charts we also have original records for the history of the voyages of the separate nations. They commence with the voyages of the Italians, who first set out independently, then in the service of Portugal, Spain and England, leaving us those grand drawings of the globe, which were continued and finished by other nations. These accordingly preceded the systematic descriptions of the world, which furnished us with but poor and scanty information in regard to the discovery of America, although the charts had already presented an almost complete picture of what was then known." Of the thirteen sheets of the atlas the first five relate to the time of Magalhaens's voyage of discovery down to its completion; the following eight explain the history of discovery to the end of the 16th century. We will here attempt to show the importance of this publication by a short extract from F. Kunstmann's explanations to the charts.

The first sheet the contents of which Schmeller had made known in his academical treatise, "On several older Sea-Charts in Manuscript," (December, 1843)—is written in the Portuguese language and bears the name of its author at its head, Pedro Reinel a fez. Barros (Dec. 1, lib. 3, c. 12) mentions a Pedro and a Rodrigo Reinel. The former was sent in 1487 to the negro-chieftain Mandimansa at the Gambia. Rodrigo is mentioned in the same year as a merchantile agent in the Oasis Ouadan on his way from Arguim to Timbuctu. In the following century, the Portuguese Sebastian Alvarez, mercantile agent at Sevilla, mentions in his account of the enterprises of Magalhaens (made July 18, 1519 to King Emanuel of Portugal,) two Reinels, father and son, omitting however their christian names. "I saw, he says, the Moluccan Islands on the globe and the chart, (en la poma y carta) which Reinel the son has made here; both were yet incomplete, when his father came to him, who finished them and put the Molluccan Islands in." For this master were also made all those charts which Diego Ribero completed, who was the assistant and probably also the pupil of the older Reinel; hence the conformity in that part of Pedro Reinel's chart which represents North America, with the northern part of America in Diego Ribero's chart. The former contains in the new world, only the eastern coast of Newfoundland and our present Labrador up to Hudson's Bay, in a continuous drawing agreeing with the report given by the Venetian ambassador Pasqualigo, (October 19, 1501) on the second voyage of Caspar Cortereal in the year 1501, from which but two Caraveles with sixty natives, without Cortereal, returned. Soon after this voyage the above chart was probably worked out in Portugal.

The second chart represents the notions of that period in which North America was believed to consist of a number of islands between which, it was hoped, a passage might be found to the Molluccas. We find here the "Terra de Corte Reall" completely separated and the terra de lauorador (Labrador) as a complete island. North of Great Britain the "Terra de Uresland" (Vresland, Frisland) is situated, a name which according to Zahrtmann is derived from Ferris land as English mariners called the Faroes. Besides this, the sheet contains the West Indies (le Antilie) the northern and part of the eastern coast of South America, the latter up to Rio de Cananor, as according to Peschel, it is often written instead of Rio de Cananea, on the Italian charts published since 1507, which were copied after Ruysch.

On the third chart, which only marks the discoveries of the Portuguese, of which the Spaniards take no notice, Labrador, (or Groenland, and the "Terra de Corte Reall" appear also as separate continents in accordance with the discoveries of C. Cortereal in his two voyages in the years 1500 and 1501. As a third continent, is seen the eastern coast of South America from Cape Roque up to R. Cananea, in conformity with the results obtained by the coast-voyage in the year 1501, in which Amerigo Vespucci took part.

The fourth chart represents North America, Labrador, Newfoundland under the name Bacalnaos instead of Bacalhaos, and the country of Corte Real as all three separated from one another by straits. In Central America the Peninsula of Yucatan appears, and the chart must therefore have been finished after the year 1517. Honduras with the islands lying before the same, the Isthmus with the Pacific coast, the latter however without nomenclature, and finally the West India Islands. The South American coast, richly furnished with names, extends southerly over the R. Cananea up to C. Santa Maria, comprising a region which was not drawn upon the former sheet, which however in Kunstmann's opinion was discovered already in the year 1501; others say, that Juan de Solis discovered it first. The original of this chart in the Military Conservatory, contains also the Eastern Hemisphere, which is not communicated in this atlas for want of space. Here the Moluccan isles are noted with the addition: "ilhas de maluqua donde vem ho cravo." The fleet which Albuquerque had sent out to open the trade with the Moluccan Islands, first reached them early in the year 1512.

The fifth sheet has been taken from an atlas which consists of seven charts and formerly belonged to the Monastery of Metten but now is preserved in the Royal Library at Munich. One chart of this atlas bears the inscription: *Vesconte de Maiollo civis Janua composuy hanc cartan in Janua*, with the year 1519, which

probably also indicates the time of origin of the other six sheets. Majolo is situated in the papal dominions, and a Jacobus de Majolo condam Vesconti, probably a son of the one mentioned above, presents himself as the author of a chart: "Janua anno Domini 1551 die 19 marsi." The chart taken from this atlas by Kunstmann commences on the American continent with the coast of Honduras, upon which the Rio de Cama Roma (Cape Cameron), and the Bay of Xagoa, both discovered in 1508, are named. Besides these the four great Antilles are noted upon it and a considerable number of smaller islands. The South American continent is also already drawn out up to the Cape of St. Maria and is richly furnished with names.

The following charts belong to a period after Magalhaens's voyage. Sheets six and seven are taken from an atlas of thirteen charts, which is kept in the Library of the University, and which can only have been drawn after the year 1534, as Cuzco is mentioned in it.

The sixth sheet commences at the eastern coast of America with the terra "che descobrio steuen comes," i. e., the country which Estevan Gomez had discovered in 1525. It contains the *terra de lecendiados*, i. e., the coasts of Pennsylvania, Virginia and Carolina, which the Licentiates Lucas Vasquez de Aillon and Matienzo are supposed to have already discovered in 1520; and also Mexico under the name *Temistitan vel Misicho*;—the central American coast, near which Yucatan is represented as an island;—the Antilles and the northern coast of South America. In the south, we perceive Magalhaens's Strait (Strictum de Magellano) with the harbor of St. Julian and Fireland, and from the western coast of America is seen a continuous stretch of Colao Provintia and Peru Provintia in the south, up to California in the north, which latter is represented as a peninsula. In the remoter part of the Pacific Ocean, several of the east Asiatic islands are noted as Dshilolo, Timor, Sumatra, and on the eastern side of Asia, Bengala Civitas and China Civitas.

The seventh sheet, taken from the same atlas, represents the countries on both sides of the Atlantic Ocean: the eastern coast of America from Newfoundland (terra de bacalaos) in the north, to Magalhaens's Strait, inclusive of that part of the Brazilian coast which is wanting on the former chart, and the coast of La Plata south to the Strictum de Magellano and the northern coast of the Fireland with the Campana de Roldan, which is called after a German companion of Magalhaens. As on the former sheet so also here the west coast of Patagonia and the coast of Chile are wanting.

The sheets eight to twelve are taken from the atlas of Vaz Dourado, the original of which with the year 1571 is found in the Archives at Lisbon. The Royal Library at Munich possesses

a much more splendid copy of the year 1580, which however deviates in many respects from the original. The eighth sheet furnishes a complete drawing of the coast of South America south of the mouth of the La Plata with Magalhaens's Strait, on which the Cape *dellas virgines* and the Fireland, which is divided into several islands, are named. The western coast of South America is abundantly furnished with names. The ninth sheet is equally rich and contains the northern half of South America; the tenth sheet has Central and a part of North America; sheet eleven gives the region where the River St. Lawrence empties into the sea, Newfoundland as an island (a part of its eastern coast appearing as a separate isle) together with the Terra de Lavrador, north of the River St. Lawrence; and finally sheet twelve gives the western coast of North America, including the peninsula and the Gulf of California.

The last sheet of the atlas reproduces an old English chart with the inscription "Thomas Hood made this platte 1592." The original belongs to the valuable collection of the Duke of Northumberland, Robert Dudley, who died 1639 at Florence in Italy. The part of America which is here represented, comprises the great Antilles, the Bahama isles, the coast of Yucatan, Mexico, Florida and Norumbega, which latter name is retained for a considerable part of the American coast south of the River St. Lawrence.

The atlas therefore comprises a great number of most valuable documents in relation to the history of the discovery of the new continent. The execution of the different sheets is so excellent, that the whole work may justly be called splendid. The text accompanying the same, contains, besides Kunstmann's comments above mentioned and the explanatory notes to the single charts, a log-book, first edited by G. M. Thomas, which was taken from a ship of Drake's third expedition (Aug. 28, 1595 until May 10, 1596,) and is preserved in the Royal Library at Munich.

THE FATE OF SIR JOHN FRANKLIN.—The following letter has been addressed to the Secretary of the Admiralty by Capt. F. L. McClintock, R. N.

"Yacht Fox, R. Y. S.

"Sir: I beg you will inform the Lords Commissioners of the Admiralty of the safe return to this country of Lady Franklin's Final Searching Expedition, which I have had the honor to conduct.

"Their lordships will rejoice to hear that our endeavors to ascertain the fate of the 'Franklin Expedition' have met with complete success.

"At Point Victory, on the northwest coast of King William's Island, a record has been found, dated the 25th of April, 1848, and signed by Captains Crozier and Fitzjames. By it we were

informed that her Majesty's ships Erebus and Terror were abandoned on the 22d of April, 1848, in the ice, five leagues to the N.N.W., and that the survivors—in all amounting to one hundred and five souls, under the command of Captain Crozier—were proceeding to the Great Fish River. Sir John Franklin had died on the 11th of June, 1847.

"Many deeply interesting relics of our lost countrymen have been picked up on the western shore of King William's Island, and others obtained from the Esquimaux, by whom we were informed that, subsequent to their abandonment, one ship was crushed and sunk by the ice, and the other forced on shore, where she has since been, affording them an almost inexhaustible mine of wealth.

"Being unable to penetrate beyond Bellot Strait, the Fox wintered in Brentford Bay and the search, including the estuary of the Great Fish River and the discovery of eight hundred miles of coast line, by which we have united the explorations of the former searching expeditions to the north and west of our position with those of James Ross, Dease and Simpson, and Rae to the south, has been performed by sledge journeys this spring, conducted by Lieutenant Hobson, R.N., Captain Allen Young and myself.

"As a somewhat detailed report of our proceedings will doubtless be interesting to their lordships, it is herewith enclosed, together with a chart of our discoveries and explorations, and at the earliest opportunity I will present myself at the Admiralty to afford further information, and lay before their lordships the record found at Port Victory." D. C. G.

Yale College Library, Oct., 1859.

ART. XLV.—*Correspondence of Prof. Jerome Nicklès, dated Nancy, August 20th*, 1859.

Necrology.—Cagniard de Latour.—This physicist died lately in his 82d year. He was born in Paris, March 31st, 1777. He entered the Polytechnic School in 1794—the year of its foundation. Two years later he left this school to enter the corps of hydrographic engineers. He soon however quitted this duty to devote himself exclusively to scientific labors. Nevertheless he accepted in 1811 administrative duties in connection with his former profession. He had already made himself known by several practical inventions—among others the adaptation of the Archimedan screw to the purposes of a blowing machine. This apparatus is still known in France by the name of *Cagniardelle*, in honor of the inventor.

In 1814, at the time when France was oppressed by the European coalition—Cagniard de Latour invented a process for polishing cannon powder, which passed immediately into use, with the best results.

About the same time he invented a portable mill for grinding wheat in camp. It weighed only seven pounds, and was employed during the disastrous campaign of the Hundred Days.

In 1818 he devoted himself to gas illumination, and largely aided the general introduction of this important industry into France. It was however in 1819 that he made his most important and beautiful invention, the *Sirene*, by which he was able to determine with accuracy the vibrations of sound. This instrument he employed upon various gases and liquids. He discovered thereby the origin of what is called technically *timbre*, that quality in sound by which instruments are distinguished from each other although sounding in the same pitch and with like intensity.

In 1822 he published his researches upon the effect produced by heat upon bodies under great pressures. He deduced from these researches the fact that a liquid may be converted into a vapor occupying the same or but little more space than the original liquid, a result distinguished by Faraday as "*the law of Cagniard de Latour.*" These expériments led to the discovery of the methods of liquefying gases.

By heating wood with steam under high pressure he obtained a tarry product resembling coal. This experiment has been repeated recently under better conditions and real coal has been thus obtained.

Cagniard de Latour is the author of the physiological theory of fermentation, which refers the chemical phenomena to the vital power of a confervoid plant. The dial-faced balance: a machine for estimating the flight of birds: the filiform hydraulic pump and the "canon-pompe," are also his inventions. Moreover he is the author of published researches on the change of volume in bodies submitted to different degrees of tension (traction). Lastly, in 1826 he constructed the Suspended Aqueduct of Crouzol, nearly two hundred meters long, and without intermediate support.

Disinfection and dressing of wounds.—For several weeks the scientific and medical world has been greatly interested by the introduction of a new and remarkable topical application for dressing wounds. Official experiments on this dressing have been made at "*la Charité*," where cancers and other affections of that kind receive special attention. The distinguished surgeon Velpeau, after experiments with this disinfectant on suppurating wounds in a putrid state, has reported favorably to the Academy of Sciences. We extract some passages from his report.

"A large mammillary ulcer with mortification of the skin was treated with the topic both in powder and in pomade. The suppuration diminished and the odor disappeared. At the same time the affected surface became cleansed and the mamma without pain.

In the case of a woman with a vast cancerous ulcer eating away all the left side of the chest, the odor of purulent pus after two daily applications disappeared.

A young man was treated whose hand was scalded by a steam boiler and mortification had supervened, involving nearly the whole of one finger. On Saturday morning this finger was in a complete state of mortification and gave out a disgusting odor, it was dressed on the morning and evening of that day with the powder in question; the bad finger was dried up immediately, the odor disappeared, and the mortification ceased.

Thus in wounds as well as on fetid animal matters disconnected with the body this topic disinfects them at once, having no trace of odor beyond a slight and not disagreeable smell of bitumen.

He adds that this mode of disinfection occasions neither pain, irritation, swelling or inflammation; it also appears rather to favor than otherwise, the progress of granulation and cicitrization; there is therefore no inconvenience in applying it to various ulcers, sores and wounds requiring to be disinfected."

Results equally favorable have been obtained at the veterinary establishment at Alfort.

The Major General of the French army in Italy, anticipating these reported results gave orders for the use of this topic immediately for the relief of the wounded. The success of this treatment has been communicated by Marshall Vaillant to the Academy. The report details the successful treatment by this means of gangrened sores upon twenty wounded Austrians in the hospital at Milan. These cases the physicians assert were of the worst possible character, and the success immediate and complete.

What is this remarkable topic? *It is a mixture of* 100 *parts of plaster of Paris with* 3 *parts of coal tar.* The mixture is easily made in a morter. Its application is made by mixing the powder with olive oil. The application either of the powder or the pomade occasions no distress even if placed in direct contact with the surface. The treatment has the double advantage of disinfecting and also absorbing the pus—thus dispensing with the employment of lint—as the late experience in Italy has abundantly proved.

This simple mixture was originally prepared for the disinfection of artificial manures. Its author is Mr. Ed. Corne, veterinary surgeon at Libos (Lot and Garonne). Mr. Demeaux, one of his medical friends, conceived the idea of applying it to the disinfection of sores, of purulent liquids and the debris of anatomical dissections. Human ordure in full decomposition and giving off an infectious odor has by this powder been instantly transformed into a odorless earthy mass.

The communication of Dr. Velpeau gave rise to an important discussion which we will now consider. M. Bussy at once recalled the fact that charcoal powder, the Boghead coke, creosote and alkaline hypochlorites have for a long time been used as disinfectants. M. Chevreul next called attention to the fact that in the last century Dr. George Berkeley, Bishop of Cloyne, had published a work on the virtues of tar-water, in which he speaks of this agent with enthusiasm. It was esteemed by him as a specific also particularly against ulcers, virus and the scurvy.

More than twelve years ago Dr. Herpin of Metz proposed a disinfecting mixture of plaster and carbon. Dumas reminded the Academy that one of its prizes was a few years since awarded to Mr. Sizet, who showed all the metallic salts which could be used with advantage in disinfection—who also added that the properties of these disinfectants were much exalted by the addition of a small proportion of coal tar. These experiments have also been confirmed elsewhere by Mr. Boussingault, without, it is true, a special reference to the treatment of sores and ulcers.

Coal tar has been used in England for disinfecting dead animals for

the uses of rural economy. The use of coal tar has also been advised for the dead on the battle field.

Dumas added that having often sought an explanation of these facts he had found it in the fact illustrated by Schoenbein that the vapor of turpentine when mixed with air produced an abundance of ozone. He thought that the vapor of coal tar oil might equally ozonize the air. In this case the odorous mixtures would be immediately burned by the ozonized oxygen and the putrid odor rapidly destroyed.

If coal tar really produces this action it is necessary, according to Dumas, to distinguish three effects. 1st, the destruction of the infectious vapor or gas by means of ozone arising from coal tar. 2d, the action of the plaster in preventing the production of new infectious gases by the solidification of the liquids present. 3d, the point of arrest set to the development of putrefactive process by any of the products contained in coal tar, and especially the phenic acid which in the smallest traces in the form of phenate of soda secures the preservation of animal matters in free air.

On the odors of perfumes.—On occasion of the discussion which we have just recorded, Mr. Chevreul offered his ideas upon the mode of action of odoriferous substances. This discussion was intended to recall the publications which this distinguished chemist has made during the past thirty years—researches made specially to trace odors to their material causes. He reviews in the following manner the action by which bodies exert their odors when properly mixed with other odoriferous materials. 1st. Bodies themselves odorant disguise the odors of other substances, as a strong light overpowers a feeble one. 2d. Bodies being themselves odoriferous act in the manner of an acid in neutralizing a base. 3d. Solid bodies may act by capillary affinity to absorb odors, as is the case for example with charcoal. 4th. Other bodies act by altering the constitution of the odorant substance, producing new compounds either odorless or nearly so. Such is the action of moist chlorine or oxygenated water. 5th. Lastly, the action may be two-fold, as in the case of chlorine and ammonia, decomposing one portion and neutralizing the other without decomposition.

Neutralization includes the largest class of cases; thus the volatile odorous acids are neutralized by alkalies to form odorless salts. Ammonia loses its odor when united to an acid. The odors in such cases are truly neutralized, since displacing the acids liberates again the odors each in its own character. Examples of the destruction of odors are numerous and well known to chemists. Sulphydric acid, for instance, is at once decomposed by chlorine and consequently disinfected. Ammonia by the action of chlorine offers an example of both neutralization and destruction of odors, because at the same time we have decomposition of one part of the base and the neutralization of another part by the chlorohydric acid formed.

M. Chevreul proposes to define odors by means of a scale, analogous to our notation of sounds, or for gradations of color by the chromatic diagram (which last device we also owe to this *savant*). The great obstacle to this plan is the difficulty of employing the sense of smell as we employ that of sight or hearing, a difficulty much increased by the toleration which the smell soon acquires to odors—becoming '*blasé*.'

In 1830 he endeavored to take account of the changing odors exhaled by the woad vats during evaporation, if possible to define exactly the kind of odor appropriate to each condition of the vat. He reached no positive results although he detected in the dye stuff bath *five* perfectly distinct odors; the odor of ammonia, a sulphurous odor, a metallic odor, an aromatic odor, clinging for many months to the woolen stuffs which had passed through the woad vat, and lastly, the odor of a volatile acid analogous to that of animal matters in decomposition. M. Chevreul hoped to detect in these odors of the dye vats symptoms to guide the dyer in his art, as the physician finds new indications in his knowledge of symptoms depending on the chemical nature of organic solids and liquids, if these symptoms can be certainly recognized by their odor. Thus he did not shrink from exposing himself to the most repulsive odors of the organism to reach his results. Having often heard the odor of a cancer spoken of as characteristic he examined it and recognized it to a compound of— 1st, an ammoniacal odor turning blue a reddened test paper. 2d, a feeble butyric odor. 3d, a heavy odor which is familiar in the 'trying out' of suet or lard. No specific odor exists then in cancers, since the three odors recognized coexist in *non-cancerous* matters which the disease alters. He recognized these matters in the odor of pus and other products of animal origin, and he also detected in them a sulphurous odor and a smell of fish, due probably to a compound ammonia.

To all these odors he adds what he calls the stale-nauseous (*fade nauseabonde*) which appears in well-water that has stood some days in a vessel in which have been placed egg shells impregnated with albumen.

[We may be permitted to add to these interesting facts some others which we submit to the distinguished author of the chromatic circle and researches on the fatty bodies.

1. If an odorous substance can be neutralized or destroyed by another odorant body there are others destitute of odor which by union produce odorant substances.

(To this class of odorless bodies belong O, S, Se, Te, C, H, As, Az, and we might add P, which is oderless unless combined.)

2. Likewise there are odorless bodies which have become odorant by union with others endowed with odor.

It is thus with oxalic, malic, butyric, racemic, citric, sorbic (the acid recently discovered by Hoffmann), boric, silicic acids, all odorless, which however produce with the elements of alcohol, ethers more or less aromatic.

3. It is necessary to distinguish those bodies which act mechanically on the olfactory membranes (e. g., ClH, FlH, BrH, IH, and the vapors of NO_3+HO, SO_3HO) from those which exert a physiological influence (for example, Cl, Br, I, NO_4, SO_2, the hydrocarbons, the essential oils, &c.).

4. It is necessary also to distinguish bodies having an odor proper, that is, an odor which exists when they form compounds with other bodies (for example, arsenic). The arsenical odor is recognized in AsH^3, $AsBr^3$, and in the cacodyl series. Tin is another example. The odor of tin characterizes a large number of stannic compounds. Sulphur: thus SO_2SH, S_2C, SNH_3, SCl, &c., are distinguished by a more or less sulphurous odor.

We might also mention napthaline, benzoin, and other hydrocarbons and organic radicals.

We see that this group of bodies characterized by a peculiar odor, embraces those elements which, like sulphur, arsenic and phosphorus, are destitute of odor, that is, their odor is manifest only in combination. If we examine these phenomena we observe (*a*) that elementary bodies are usually destitute of odor; (*b*) that in general the least odorant compounds are oxygen compounds; (*c*) highly odorant compounds are usually those containing hydrogen. These seemingly singular facts may to a certain extent be explained when we remember that in general chemical compounds become less volatile as they fix oxygen, which by union with hydrogen they become more volatile. But these considerations do not explain all; they do not tell us why CO and CO_2 are odorless gases, while $C_{12}H$, $C_{26}H_8$, $C_{12}H_6$, &c. &c., are odorant.

Moreover the perfumes properly so called, as musk and the aromatic essences, rose, lemon, orange, bergamot, lavender, &c. are eminently hydrogen compounds. They are not all volatile and some of them may be exposed to the air for years, exhaling odor all the time, with no sensible loss of weight. Among these are the perfumes isolated by Milon in 1856.* The cause of odors is not referable exclusively to the phenomena of volatility, although as a general thing the odor of most bodies is developed when they are volatilized.

Hydrogen must be considered, par excellence, the exciting cause of odors. This element possesses above all other substances the peculiar property of developing odors even with odorless bodies, as N, C, Se, Te, P, &c., and a great number of compounds, of these and other elements.

Oxygen on the other hand appears to act the chief part in the perception of odors; it seems indeed proved that odors are not recognizable where there is not oxygen in the air to bathe the olfactory membranes.]

Humboldt Foundation.—[After mentioning this foundation, of which we give a more detailed notice on a subsequent page of this volume, our correspondent adds:—] We remark that this foundation resembles the Society for Aiding the Friends of Science, with this difference, that the Humboldt Foundation proposes particularly to aid rising talent and to encourage scientific explorations, while the Society for the Friends of Science sustains scientific men in declining health and comes to the relief of their widows and orphans. The two organizations are therefore complementary to each other, and are worthy to go on side by side.

Photography by Carbon. Concours for the prize founded by the Duke of Luynes.—We have for some years past discussed this photographic question—the object of a prize established by a distinguished amateur, the Duke of Luynes. It is required to discover a method by the use of carbon alone, neglecting salts of gold, silver, and other metals, to produce photographs, this being the only material which submitted to the test of time has transmitted to us without change records almost 3000 years old. The Concours has been held; but unfortunately the Commission of the Photographic Society, to whom it was referred, are unable to announce a full success and the trial has been adjourned for three years.

* This Journal, July, 1856, p. 109.

Many persons contested the prize. The desideratum is to obtain a coating of carbon in a manner analogous to that from silver or gold, namely, by reduction. But chemistry as yet has failed to discover a process for the reduction of carbon compounds, and photographers have resorted to animal black which they have applied in any convenient manner to plates previously exposed to the sun. We give a *résumé* of the new results in two memoirs esteemed by the Commission worthy of reward.

Messrs. Garnier and Salmon, the authors of one of these memoirs, cover the surface of paper with a film obtained from an intimate mixture of bichromate of ammonia and albumen. This coating is dried by heat and exposed to the sun in a frame covered by a glass positive. The picture appears in a yellow-brown tint which becomes more intense by a gentle warmth. The sheet thus prepared is fixed on a planchette and covered with finely powdered ivory-black, the coating being made even by a stump of cotton. It is next detached and plunged in common water, the image uppermost, and there gently moved at intervals for a quarter of an hour. The water is then drawn off and the picture served in a bath composed of 5 parts of concentrated sulphurous acid diluted in 100 parts of water, moving it about as before at intervals. After this double process the carbon almost entirely disappears from the lights and clear spaces, while it remains in quantities proportional to the greater or less intensity of action of the light upon the other portions, and thus the proof finally reproduces the positive, but not perfectly, since the lights and half tints are not pure and the blacks lack somewhat of brilliancy and perfectness. But the process is simple and good; it remains only to perfect it.

M. Pouncy, another competitor, operates a little differently, but obtains results equally satisfactory. His process differs in applying the carbon before exposure of the proof to light, the sensitive coating being formed at once, of bichromate of potassa, gum arabic and finely divided carbon, exposed not under a positive but under a negative plate. On removal the plate is placed in a bath of pure water; after five or six hours immersion he washes under a cock of common water and the carbon positive is obtained.

In this process the manipulation is a little easier and more simple. The use of a negative authorized the expectation of a better result, but the exposure is longer than in the mode of Garnier and Salmon, whose use of a positive avoids the chances of accident which attend the negative plates in the hands of the operator.

Messrs. Pouncy, Garnier and Salmon share the prize with Mr. Poiterin, who has the merit of anticipating these photographers, whose methods are only an advance on the process which Mr. Poiterin published in 1856.

Transformation of cellulose into sugar.—We have already spoken in this Journal* of the plan of Pelouze for facilitating the experiment of Braconnot—the transformation of cellulose into sugar—by exposing the woody fibre and dilute acid to high pressure and heat. It is known, and the fact is recognized by M. Pelouze himself, that this idea has been some years since put in practice both by Mr. Weil and also by Mr. Tribouillet, who obtained a patent for the process.

* This volume, page 126.

Transformation of cellulose into parchment or parchment-paper.—It appears that this curious product of the action of concentrated sulphuric acid on bibulous paper, by which means the paper is changed to a tissue very much resembling ordinary parchment, nearly as strong and resisting the action of boiling water, which parchment does not. It appears that this is not a new observation, but was first made known in 1846 by Messrs. Poumarêde and Figuier in the Journal de Chemie et de Pharm. for 1847, under the name of *papyrine.* This product however was prepared by aid of an acid of less concentration than is used for parchment-paper and consequently it did not possess all the desirable properties belonging to vegetable parchment, which is susceptible of a multitude of important applications.

Acclimation. The Dromedary imported into South America.—On the 21st of June last the ship "*Splendide*" of Marseilles sailed from the port of Algiers for Brazil, having on board fourteen camels (four males and ten females) selected and purchased by the Society for Zoological Acclimation (*Société Zoologique d'Acclimation*) to the order of the Brazilian government; this government having decided to test the acclimation of these animals in the sandy provinces of Brazil. Several of these provinces, particularly Céara, during many months of the year are destitute of water, and much resemble in physical characters those regions of Africa and Asia where the camel and dromedary are so eminently serviceable.

The Society of Acclimation, in view of the importance of the case, have sent one of the Vice Presidents of the society, M. Richard (du Cantal), a distinguished zootechnist, to Algeria, between Boghar and Lagonat, in a region inhabited by one of the tribes most distinguished for the number and beauty of their dromedaries. From these herds Richard selected ten females of three to four years old, three males of four years, and one of seven, all in the highest condition, at a cost of 380 francs each. Four Arab camel drivers were also obtained to accompany the animals.

The July (1859) number of the Journal of Acclimation relates all the history of this experiment, to which we refer for the details. But it is to be remarked as regards the prospect of success for this enterprize that a similar experiment has met with success some time since in Texas and Central America, the credit of which is due to Major Wayne of the United States Army.

BIBLIOGRAPHY.—There has appeared from the central book depot of Agriculture at Paris

Dictionnaire raisonné d'Agriculture et d'Economie du Bétail par le Dr. Richard, du Cantal, 2 vol. in 8vo.—Richard is one of the Vice Presidents of the Society for acclimation spoken of above. He is best known for his intimate knowledge concerning domestic animals and especially of what in France is called *Zootechny.* The two volumes of his Dictionary are filled with his observations on this important agricultural question.

MALLET-BACHELIER, quai des Augustines, Paris, has published—

Recherches sur les Météores et sur les lois qui les régissent par Coulvier Gravier. 1 vol. in 8vo, with numerous plates.—Mr. Coulvier Gravier has brought out in this volume the fruit of forty years of observations on the state of the heavens. We have often found occasion to mention his ob-

servations on shooting stars. This work embraces all belonging to what are called *meteors.* The author is under great obligations to the French government who, on the recommendation of Arago, placed Mr. Coulvier Gravier in a situation to follow his tastes for this sort of observation. This observer does not despair of obtaining the means of predicting the meteoric *periods.* He unfolds his theory in a volume which all can understand, since it is written in a simple style and contains few mathematical formulæ. It shows that the author has obeyed a controlling taste; and his work fills an important gap in astronomical bibliography.

Cours de Mecanique appliqueé par M. Mahistre. 1 vol. 8vo, illustré de 211 figures.—Mr. Mahistre is professor of Mechanics *a la Facultè des Sciences a Lille,* one of the great manufacturing centers of Europe. His admirable work is especially adapted to engineers and to students who are destined to industrial pursuits.

Cours de Mécanique appliquée par M. Bresse. T. 1.—Mr. Bresse is Professor of Mechanics at the celebrated *Ecole des Ponts et Chaussées.* This first volume treats specially of the strength of materials. Like the work of Mahistre, it is particularly adapted to civil engineers; above all it interests the engineers of bridges and roads, who in France occupy so important a rôle, particularly in railroad constructions. Multitudes of these engineers are found scattered over the continent of Europe, especially in Russia, Germany, Spain, Switzerland and Belgium. The science of the pupil gives evidence of the master, who is Mr. Bresse.

Cours d'Electrophysiologie par M. Matteucci. 1 vol. 8vo.—This course pronounced at the University of Pisa is now reproduced in France where the well known high reputation of the author will secure it the attention it deserves.

Cours d'Analyse de l'Ecole Polytechnique par M. Sturm. T. II, in 8vo, 1859.—We have already announced the first volume of this great mathematician, who died some years ago. It is published by one of his pupils, Mr. Proutret, by the choice of the author, and from the manuscript left by him. This work is of special value to professional mathematicians, and to those who are charged with the instruction of this science.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On Torsion and its relations to Magnetism.*—Wiedemann has communicated several interesting papers on torsion and its relations to magnetism, from the last of which we extract the following comparative view, referring to the original paper for the details of the experimental methods employed.

Torsion.	*Magnetism.*
1. The temporary torsions of a wire twisted for the first time by increasing weights, augment more rapidly than the weights.	1. The temporary magnetisms of a bar magnetized for the first time by increasing galvanic currents, augment more rapidly than the intensities of these currents.

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2. The permanent magnetisms of the rod increase still more rapidly.

3. A much weaker counter current is necessary to demagnetize the bar, than to magnetize it.

4. In a case of repeated magnetizations of the bar, its magnetisms approach more and more closely to a proportionality with the intensity of the magnetizing currents. The magnetisms are thereby greater than in the first magnetization.

5. By repeated application of the same magnetizing and demagnetizing currents, J. and −J. the maximum of magnetism reached in the magnetization, sinks, and the minimum of the same reached in the demagnetization rises up to a certain limit.

6. When magnetized beyond the limits of the repeated magnetizations and demagnetizations, the bar behaves as if it were magnetized for the first time.

7. A magnetized bar which is demagnetized by a current of the intensity −J cannot be magnetized in a direction contrary to that of the first magnetization by repeated action of the current −J. But the current +J magnetizes it easily in the first direction.

8. When a bar which has the permanent magnetism A is brought by the current *b* to the magnetism B, and then farther to the magnetism C, which lies between A and B, we need the current *b* a second time in order to communicate again the magnetism B. In this case A may also be 0, and B may be greater or smaller than A.

9. Vibrations during the action of a magnetizing current, increase the magnetism of a bar.

10. The permanent magnetism of the bar after removing the magnetizing current is on the contrary, diminished by vibrations.

11. A wire twisted and then untwisted loses or gains torsion by vibration according to the magnitude of the detorsion.

11. A magnetised and then demagnetized bar loses or gains magnetism by vibration, according to the magnitude of the demagnetization.

12. The permanent torsion of iron wires diminishes by their magnetization, and that in a ratio which diminishes as the magnetism increases.

12. The permanent magnetism of steel bars diminishes by their torsion and that in a ratio which diminishes as the torsion increases.

13. Repeated magnetizations in the same direction scarcely diminish the torsion of the wire. A magnetization in the opposite direction to the first produces however a new strong diminution of the torsion.

13. Repeated torsions in the same direction diminish the magnetism of a steel bar but little. A torsion in a direction opposite to the first, produces, however, a new strong diminution of the magnetism.

14. When a wire, by frequent magnetizations in opposite directions, is untwisted as far as possible by this process, it assumes by magnetization in one direction a maximum, by magnetization in the opposite direction a minimum of torsion.

14. When a bar by repeated twisting and untwisting is demagnetized as far as this is possible by torsion within definite limits, it assumes a maximum of magnetism by torsion in one, and minimum by torsion in the opposite direction.

15. A twisted wire which has been partially untwisted, loses by magnetization much less of its twist than an ordinary twisted wire. A wire farther untwisted, exhibits on feeble magnetization at first an increase of its torsion, which by augmenting the magnetization rises to a maximum and then again diminishes. The more strongly the wire was untwisted, the stronger must the magnetism be, in order to reach this maximum. When the wire is very strongly untwisted, its torsion increases, even up to the application of the strongest magnetization.

15. A magnetized bar which has been partially demagnetized, loses by torsion much less magnetism than an ordinary magnetized bar. A bar, which has been farther demagnetized, exhibits on feeble torsion, at first, an increase of magnetism which on increasing the torsion, rises to a maximum and then again diminishes. The more strongly the bar was demagnetized, the stronger must be the torsion to reach this maximum. When the bar is very strongly demagnetized the magnetization increases even up to the application of very strong torsions.

16. When a wire is magnetized while under the influence of the twisting weight, its torsion increases by weaker, diminishes by stronger magnetization.

16. When a steel bar is twisted when under the influence of a magnetizing current, its magnetism increases by weaker, diminishes by stronger torsion.

17. A wire twisted at the ordinary temperature loses torsion by heating, and on cooling again recovers a portion of its loss. The changes increase with increasing torsion. After repeated changes of

17. A bar magnetized at the ordinary temperature, loses magnetism by heating, and on cooling recovers a portion of its loss. The changes are proportional to the magnetization. After repeated changes of

temperature, the wire arrives at a constant state, in which to every temperature corresponds a definite torsion of the wire, which diminishes as this temperature increases.	temperature, the bar arrives at a constant state, in which to every temperature corresponds a definite magnetism of the bar, which diminishes as the temperature increases.
18. A wire twisted at the ordinary temperature, and then partially untwisted, loses on heating so much the less of its torsion, the farther it has been untwisted. Upon cooling, its torsion is less than before if the detorsion has been slight, but greater if this has been considerable.	18. A bar magnetized at the ordinary temperature, and then partially demagnetized, loses by heating so much the less of its magnetism the farther it has been demagnetized. On cooling, its magnetism is less than before when the demagnetization has been slight, but greater when this has been considerable.
19. A wire twisted at a higher temperature, loses torsion on cooling. Upon a second heating, it again loses, and upon a second cooling first regains a portion of its loss. When the wire is vibrated previous to the first cooling, it immediately gains in torsion.	19. A bar magnetized at a higher temperature loses magnetism on cooling. By a secong heating it again loses, and by a second cooling first regains a portion of its loss. If the bar is vibrated previous to the first cooling, it immediately gains in magnetism.

From this comparison it will be seen that there is an analogy between the phenomena of magnetism and those of torsion, which holds good even in the details. The author remarks that this result is incompatible with the old assumption of the existence of magnetic fluids, but that we cannot justly infer from it, that the magnetism of a bar depends upon torsion. This is not proved by experiment; moreover as he proposes to show in another memoir, similar relations are found in the case of other molecular displacements, as for example, in flexion.—*Pogg. Ann.*, cvi, p. 161.

2. *On the densities of vapors at high temperatures.*—H. Sainte Claire Deville and Troost have continued their investigations on the densities of vapors, employing the apparatus already described, but substituting the vapor of boiling cadmium (860° C.) or of zinc (1040° C.) for the vapors of mercury and sulphur, used in their former experiments. The vessels employed were of porcelain, instead of glass, and could be hermetically sealed by means of the compound blowpipe. To avoid the difficulties of a precise determination of the temperature, the authors always employed vessels of the same substance and of the same capacity, in which they enclosed successively vapor of iodine and the vapor of the body experimented upon. In this manner, the ratio of the densities of the two vapors was determined—the density of the vapor of iodine having been previously accurately determined. By this process the determination of the temperature becomes unnecessary. The authors results were as follows:

Sulphur, at the temperature of 860° has a vapor density of 2·2, and this density does not change as the temperature rises, being the same at 1040° as determined by more than twelve experiments. We may there-

fore admit with certainty that the equivalent of sulphur (16) represents one volume of vapor, like oxygen (8).

The vapor of selenium presents the same anomalies as the vapor of sulphur. At 860° its density is 8·2; at 1040° it is not more than 6·37. The authors propose to determine the density of this substance at still higher temperatures.

The vapor density of phosphorus at 1040° is 4·5=1 vol., corresponding to the equivalent generally adopted. The vapor density of cadmium at 1040° is 3·94=2 vols. Calculated on this hypothesis it would be 3·87.

At 1040° the vapor density of sal-ammoniac is 1·01=8 vols. (calculated =0·92.) The observed vapor density of bromid of aluminum is 18·62=2 vols. (calculated =18·51).

The vapor density of iodid of aluminum in like manner corresponds to 2 vols., and is 27·0 by observation; 27·8 by calculation.

These two last numbers are calculated from experiments made in the vapor of sulphur. The iodid of aluminum exhibits a singular property indicating that its elements are united by a very feeble affinity. This iodid fuses at 125°, boils at 350°. At this temperature its vapor behaves as if it were composed of pure aluminum in a peculiar state of insulation; it burns in the air on contact with an ignited body, giving iodine and aluminum. It explodes by the electric spark when mixed with oxygen, in a strong vessel.—*Comptes Rendus*, xlix, p. 239.

3. *On organic compounds which contain metals.*—FRANKLAND has published a fourth memoir in continuation of his investigations of the compounds of metals with organic radicals. By the action of zinc-ethyl upon the iodid of stannethyl, the author obtained a crystalline compound of iodid of zinc and bi-ethyl-tin, having the formula $Sn(C_4H_5)2+ZnI$, the reaction being represented by the equation

$$SnC_4H_5I + ZnC_4H_5 = (Sn(C_4H_5)2 + ZnI).$$

When this compound is distilled, the distillate washed with water and again distilled, bi-ethyl-tin passes over as a clear colorless liquid, of a faint ethereal smell, and a somewhat metallic but not disagreeable taste. The density of its vapor is 8·021, which corresponds to 1 vol. of tin-vapor and 4 vols. of ethyl, the 5 being condensed to 2. It boils at 181° C. and distils over unchanged. It burns with a dark deep blue bordered flame giving off white vapors of oxyd of tin. Bi-ethyl-tin like zinc-ethyl is not capable of uniting with any other element unless an equivalent of ethyl is separated at the same time. Iodine forms with it a compound having perhaps the formula $Sn_2(C_4H_5)2I$, though it may be the compound described by Cahours and Riche, $Sn_2(C_4H_5)3I$.

By the action of methyl-zinc upon iodid of stannethyl, Frankland obtained a colorless liquid having the formula $Sn\left\{\begin{matrix}C_4H_5\\C_2H_3\end{matrix}\right.$ which he terms ethylo-methylide of tin, the vapor density of which also corresponds to 2 vols.

When zinc-ethyl is brought into contact with the iodid of methyl-mercury, $Hg\left\{\begin{matrix}C_2H_3\\I\end{matrix}\right.$, iodid of zinc is separated after a few hours, and on distillation, bi-ethyl-mercury is obtained. This body agrees completely with

the ethylide of mercury described by Buckton. Its formation may be represented by the equation

$$Hg(C_2H_3)I + 2Zn(C_4H_5) = Hg(C_4H_5)2 + Zn(C_2H_3) + ZnI.$$

This result exhibits a mobility in the atomic groups of these compounds which could scarcely have been expected.

By the action of zinc-methyl upon the chlorid of mercur-ethyl and subsequent distillation, the author obtained only a mixture of ethylide of mercury, $Hg(C_4H_5)2$, and methylide of mercury, $Hg(C_2H_3)2$, but considers it probable that in the above reaction an ethylomethylide of mercury is actually formed, but that this is subsequently decomposed by distillation.

In a previous memoir, the author showed that the vapor density of zinc-ethyl requires the formula $Zn_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$; nevertheless it was not found possible to produce the intermediate compound, $Zn_2\left\{\begin{matrix}C_4H_5\\C_2H_3\end{matrix}\right.$.

Frankland did not succeed in preparing zinc-methyl by the action of iodid of methyl upon zinc in a copper digester, although the process usually succeeds in small glass tubes. When a solution of iodid of methyl in ether is treated with zinc in the copper digester, zinc-methyl is formed in large quantity, but on distillation a body is obtained which has the formula $2Zn_2\left\{\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right. + \left.\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right\}O_2$, and which therefore appears to be a definite compound of zinc-methyl and ether. The vapor density of this liquid is 3·1215, which corresponds to 2 vols. of the vapor of zinc-methyl and 1 vol. of the vapor of ether united *without* condensation. As this result is *à priori* improbable, Frankland remarks that a mixture of zinc-methyl vapor and ether vapor in the above proportions would have the density 3·0413, without however definitely adopting either view.—*Ann. der Chemie und Pharmacie*, cxi, 44.

4. *On the isomorphism of stannic, silicic, and zirconic acids.*—The observation of Marignac that the fluostannates and fluosilicates are isomorphous, renders it necessary to assume that silicic acid, like stannic acid, contains two equivalents of oxygen. G. Rose directs attention to the fact that zircon has the same crystalline form as tinstone, and agrees with this also in the cleavages. The isomorphism of zircon with one of the forms of titanic acid is still more close, although zircon has not like rutile and tinstone been found in twin crystals. The author remarks that zircon must be regarded as an isomorphous combination of one atom of zirconic and one atom of silicic acids. It appears however that there are some varieties of zircon in which the two acids are united in other ratios. Hermann has examined a zircon containing two atoms of zirconic and three of silicic acids, and has named the mineral Auerbachite; it has the same crystalline form as ordinary zircon.—*Ann. der Physik und Chemie*, cvii, 602.

5. *On the equivalent of manganese.*—The equivalent of manganese was determined by Berzelius as 27·56, from two analyses of the chlorid. Von Hauer has recently found for this equivalent the number 27·5 by reducing anhydrous sulphate of manganese by sulphuretted hydrogen to sulphid of manganese. His result, 27·5, was the mean of nine experi-

ments. Dumas, in his well known memoir on the equivalents of the elements, asserted that he had determined the equivalent of manganese by reducing an artificial peroxyd to protoxyd by means of a current of hydrogen, and that he had found the number 26, as he expresses it, *d'une manière absolue*. In a later communication, however, he gives the number 27·5 as the true equivalent of manganese, the same being determined by the method of Berzelius. Schneider objects to the methods of Berzelius and of von Hauer, believing that both are subject to constant sources of error. He has therefore determined the equivalent anew by the method already employed by him with cobalt and nickel, viz., by the analysis of pure neutral oxalate of manganese, the ratio between the carbon and manganese being sufficient for the purpose. In this manner four experiments closely agreeing with each other gave as the equivalent of manganese 27·019, or in round numbers 27. This result is further confirmed by the experiments of Rawack made in Schneider's laboratory, by reducing the oxyd of manganese, Mn_3O_4, in a current of dry hydrogen to protoxyd. Six experiments gave as a mean, 27·009 for the equivalent. —*Pogg. Ann.*, cvii, 605.

6. *On the equivalent of nickel.*—SCHNEIDER has furthermore revised his experiments on the equivalent of nickel, in consequence of the objection of Marignac, that the oxalate of nickel employed in his former determinations may have contained free oxalic acid. Three experiments, in which the ratio of the nickel to the carbon was determined, led as before to the equivalent 29, neglecting decimals in the second and third places.

In a third paper on equivalents and on the determination of equivalents in general, Schneider has given a very severe, but at the same time, very just criticism of Dumas' two memoirs on the atomic weights of the elements.

7. *On an easy mode of preparing metallic chromium.*—WÖHLER has given a very simple method of preparing metallic chromium by the action of zinc upon the violet chlorid. The process is as follows: one part of chlorid of chromium is mixed with two parts of chlorid of potassium and sodium, the mixture introduced into a common crucible packed tight, two parts of granulated zinc laid upon it, and covered with a layer of alkaline salt. The crucible is then heated till the mass fuses. When on removing the cover for an instant, a zinc flame is observed, accompanied by a peculiar sound, the heat is diminished by closing the draught, and the mass kept about ten minutes in fusion. The crucible is then to be removed from the fire, gently struck to collect the metal, and allowed to cool. On breaking the crucible, a well fused regulus of zinc is found under a green slag. After being well cleaned in water, it is to be placed in dilute nitric acid, which is to be frequently renewed till all the zinc is dissolved. The chromium remains as a crystalline powder, which is again to be heated with nitric acid and then well washed.

As thus prepared, chromium is a bright gray, highly crystalline powder. Under the microscope, the crystals are distinctly seen to be very sharp rhombohedrons of great lustre and almost tin-white color. Its specific gravity is 6·81 at 25° C.; it is not magnetic. Heated in the air, it oxydizes, becoming yellow and blue like steel, and gradually becomes covered with a thin layer of green oxyd. When heated in chlorine, it

glows vividly and becomes violet chlorid. Chlorhydric acid dissolves it easily to the blue protochlorid. Dilute sulphuric acid which dissolves iron easily is without action upon chromium; but on gently warming a very violent action sets in and the remaining metal now acquires the property of being easily dissolved after washing even by the most dilute sulphuric acid. Concentrated and boiling nitric acid does not attack it in the least.—*Annalen der Chemie und Pharmacie*, B. cxi, p. 230.

W. G.

II. BOTANY AND ZOOLOGY.

1. *Two new Genera of Diœcious Grasses of the United States;* by GEORGE ENGELMANN, M.D. Extr. from the *Transactions of the Academy of Natural Sciences of St. Louis, Missouri*, Vol. I, p. 431–442, with three plates, 8vo. August, 1859.—The *Buffalo-Grass*, so abundant and so widely diffused over the broad, arid region which separates our Pacific from our Atlantic possessions, is one of the humblest plants of its order, rising only a few inches above the surface of the soil; but at the same time it is one of the most important and useful, since it forms the principal subsistence of the Buffalo, for a part of the year, and no less so of the cattle of the emigrant. The botanical history of this little grass, now happily completed by Dr. Engelmann, is remarkable. Nuttall first named and described it, nearly thirty years ago; and, while he referred it to *Sesleria*, suspected it to be *sui generis*, and threw out a happy conjecture as to its natural relationship. Torrey figured it twelve years ago, and also announced its affinity to the *Chlorideæ;* he at the same time discovered its diœcious character, and showed that only the male plant was known. At length Dr. Engelmann has detected the female plant in a rather rare grass, the *Anthephora axilliflora* of Steudel, which is so unlike the common Buffalo-Grass that it naturally had been referred to a widely different tribe. Struck by the similarity of their foliage and stoloniferous growth, as they occurred together in a collection made by his brother, Dr. Engelmann shrewdly suspected the relationship, and finally set the question at rest by finding a male Buffalo-Grass which happened to bear a stalk of female flowers from the same rootstock; and these flowers were those of the so-called *Anthephora*. So different are the two that nothing short of this ocular proof would have been convincing. It hardly need be said that the male plant is not a *Sesleria*, nor the female an *Anthephora;* although they severally resemble these genera, or at least the female spikelets have a very great external resemblance to the Paniceous genus *Anthephora*. So that, Dr. Engelmann, having to characterize this new generic type, very naturally named it *Búchloë*, (as shorter and more euphonous than *Bubalóchloë*), i. e. Buffalo-Grass; and he retained the specific appellation of *Dactyloides*, although the male plant is not much like a *Dactylis*, and the female wholly unlike. Very glad we are to see the genus established under so appropriate a name,—the more so as it has narrowly escaped a different fate. That is to say, two inchoate attempts seem to have been made to found a genus upon the male sex. First, in Sir William Hooker's enumeration of the plants of Geyer's western collection, we find "*Calanthera dactyloides*, Kth.—Nutt. Sesleria, *Nutt. Gen.* v. i, p. 65." But neither Kunth nor any

other author has described a genus *Calanthera*. We have a suspicion that the "Kth." is a slip of the pen, and that the name is really Nuttall's, given by him to a specimen in the Hookerian herbarium. But if this be so, the manuscript name (which, moreover, is destitute of any particular significance) can by no means now supersede Engelmann's published one; though we might have been constrained by courtesy to adopt it, if this suspicion had occurred to him, and he had been able to confirm it. Again, in the corrections at the close of the *Plantæ Hartwegianæ*, Mr. Bentham applies the name of "*Lasiostega humilis*, Rupprecht (ined.)" to No. 250, which he had before called a *Triodia*. The plant is undoubtedly a male Buffalo-Grass. But no genus *Lasiostega* is found to be published, nor has this name any appropriateness as applied to the plant in question.

It is curious to remark that the male plant, being more proliferous by stolons than the female, has nearly displaced the latter, or has (so far as known) attained a wider geographical range as well as a far greater abundance. Probably, in accordance with a general law, the tendency to barrenness from seed which accompanies copious multiplication by offshoots, has also assisted in the production of this result,—a state of things quite contrary to the genius of that polygamous community which has effected a lodgement in the region of Buffalo-Grass.

Dr. Engelmann's second genus, *Monanthochloë*, is founded upon a singular, exceedingly stoloniferous, littoral grass, with leaves scarcely half an inch long, with solitary sessile spikelets, which has long been known to occur on the coast of Texas and Florida (collected by Berlandier, Drummond, and Blodgett), but has never been studied until now. In fact it has been thought to be something abnormal, on account of its showing as its most interesting feature, a regular transition from the foliage to the paleæ of the flowers. Dr. Engelmann notes that the glumes are wanting [perhaps represented by ordinary leaves of the axis of which the spikelet is a direct continuation], the uppermost leaf representing the lowest palea of the spikelet. The latter consists of three to five flowers, of which the lowest flower and sometimes the next are neutral or rudimentary, from one to three succeeding ones are staminiferous or pistiliferous, according to the sex, and the uppermost is also reduced to a rudiment. In the hands of agrostologists such a grass as this will be likely further to elucidate the floral structure of the order, the theory of which is by no means settled yet. Dr. Engelmann's three excellent plates, displaying all the details of the flowers, will facilitate this investigation.

The youthful Academy of Natural Sciences of St. Louis is well inaugurating its public career by publications of such character as this paper, and the more elaborate *Monograph of Cuscuta* by the same author, which is now in press. A. G.

2. *Trichomanes radicans*, Swartz.—The discovery of this Fern in Alabama by Mr. Peters and Mr. Beaumont, along with a minute new species, allied to West Indian ones, was announced in this Journal several years ago. More recently Mr. Eaton has detected indications of *T. Petersii* in West Florida, where *T. radicans*, also, will probably yet be found. We have now to state that the Rev. Dr. Curtis has discovered a locality of the latter species, during the past summer, in the Cumberland Mountains, in the eastern part of Tennessee, under the ledge of a dripping rock. Con-

trary to what would have been expected of the habitat of such a Fern, the district is very far from humid, as may be inferred from the paucity of fleshy Fungi. A. G.

3. *Thesaurus Capensis: or Illustrations of the South African Flora, being Figures and brief Descriptions of South African Plants, selected from the Dublin University Herbarium;* by WM. H. HARVEY, M.D., F.R.S., &c., Prof. Bot. Univ. Dublin, &c. Dublin, vol. I, No. 1, 1859.—The Nos. contain 25 plates each: the present one is accompanied by 16 pages of letter-press, all in octavo. The work is designed to be a running supplement and iconography of the Flora Capensis, now in preparation by its author in connexion with Dr. Sonder. It is published in quarterly parts (at 5 shillings sterling each), four to a volume of one hundred plates, with descriptions. The author is pledged to finish the first volume, and intends to continue it through five or six volumes, if encouraged by the sale of the first. As "the impression is limited to 250 copies, 150 of which are reserved for colonial sale," we cannot doubt that Prof. Harvey's moderate expectations in this respect will be satisfied. A few copies should be secured in this country,—for which Prof. Gray of Cambridge will receive subscriptions. The *profits* of the sale, *if any*, are to be devoted to the University herbarium, of which the author is the curator. The plates are very good for general habit and appearance, but the lithographic printer has not done full justice to the author's drawings on the stone. The analyses are doubtless very correct. We venture to suggest, however, that they do not always tell all that could be desired, nor does the letter-press supply the deficiency in such cases. For example take the three *Rubiaceæ* illustrated. It is not made to appear that the placentæ of the *Gardenia* are parietal, nor is the insertion of the ovules in the *Kraussia* and *Mitrastigma* made known, nor is any character mentioned to distinguish the latter from *Canthium*, to which it has been referred. A. G.

4. *Grisebach's Outlines of Systematic Botany, for Academical Instruction* (*Grundriss der Systematischen Botanik, &c.;* von A. GRISEBACH) Göttingen, 1854, pp. 180, 8vo.—A convenient manual for the class-room, and well devised for that purpose. In the classification the arrangement of the orders and the higher groups follows a new and somewhat peculiar fashion. Like all such attempts, it is happy in some associations, and very much open to criticism in others. It is enough to say that, evidently, the scientific grounds of an arrangement of the orders according to nature have not yet been discovered and applied; until they are discovered all our endeavors at shaping forth the system of nature are merely tentative; and the most that can be said of the best of them is, that it is less faulty than others. A feature in this little work which is original, so far as we know (although something much like it has been devised by Dr. Pickering), and well worthy of adoption, is the neat formula for expressing the numerical plan of the flower in an order or genus, &c., and also the degree of union or consolidation. Thus, the type of *Caryophyllaceæ* is expressed by the formula, 5, 5, 10, $\widehat{3}$. These numbers represent the number of parts in the several floral organs, beginning at the left with the sepals; the second figure represents the petals; the next the stamens; the last the pistil. The curved line over the latter indicates

the union of the three carpels into a compound pistil. Take now for example, a few of the genera:

Silene, $\widehat{5}$, 5, 10, $\widehat{3}$. *Dianthus*, $\widehat{5}$, 5, 10, $\widehat{2}$.

Cerastium, $\widehat{5}$, 5, 10, $\widehat{5}$. *Sagina*, $\widehat{4}\text{–}\widehat{5}$, 4–5, 4–5—8–10, $\widehat{4}\text{–}\widehat{5}$.

Corrigida, $\underbrace{\widehat{5}, 5, 5}$, $\widehat{3}$. *Scleranthus*, $\underbrace{\widehat{5}, 0, 10}$, $\widehat{2}$.

The 0 expresses the absence of that part of a complete flower. While the curved line above indicates *connation*, or union of the several parts of a whorl, the bracketed lines underneath express *adnation*, the union of the parts of successive cycles. The character ∞ stands for an indefinite number, as used by DeCandolle. So the formula for ***Malvaceæ*** is $\widehat{5}$, 5, $\widehat{\infty}$, $\widehat{\infty}$.

For *Hypericineæ*, $\widehat{5}$, 5, $\widehat{3\infty}$ —$\widehat{5\infty}$, $\widehat{5}$. *Rosaceæ*, $\underbrace{\widehat{5}, 5, \infty}$, ∞.

Commelynaceæ, 3, 3, 6, $\widehat{3}$. *Irideæ*, $\underbrace{3, 3, 3, \widehat{3}}$.

Gentianeæ, $\widehat{5}$, $\underbrace{\widehat{5}, 5}$, $\widehat{2}$. *Scrophularineæ*, $\widehat{2:3}$, $\widehat{3\text{–}2}$, 2 : 2, $\widehat{2}$.

Rubiaceæ, $\underbrace{\widehat{5}, \underbrace{\widehat{5}, 5}, \widehat{2}}$.

The botanist will perceive the whole plan at a glance. It is equally applicable to the genera; a word or two in addition expressing the nature of the fruit, or any peculiarity of structure. A. G.

5. *Structure and growth of Rootlets.*—According to the Gardener's Chronicle, Prof. Henfrey has published an interesting paper, in the Journal of the Royal Agricultural Society, on the structure of roots. The points which are spoken of as novel and practically important are—1, that "the growing point of a root is not at its absolute extremity, which is covered by a cap-shaped or hood-like portion of epidermis of its own, continuous likewise behind with the cambial structure. This cap-like sheath of the point of the root may be compared with the head of an arrow, forming a firm body, which can be pushed forward by the growing force behind to penetrate through the resisting soil . . . . When it undergoes decomposition in proportion as it is renewed behind, it presents an irregular ragged appearance, which probably gave rise to the idea of a spongy structure at the ends of the rootlets:" i. e. the spongioles of DeCandolle. 2. That in *many* cases there are present upon the young root infinite multitudes of little hairs, through which food is imbibed, and by which the absorbing power of the surface of the root "is considerably augmented." However it may be in England, these are both matters of elementary knowledge in the United States, and have been for the past ten years.—In the Annales des Sciences Naturelles for 1858, published in 1859, Garreau and Brauwers have an article upon the same subject, bringing out essentially the same familiar facts. They, however, direct attention principally to the continued exfoliation of these root-points, by which, in some cases, considerable organic matter is thrown off into the soil,—offering an explanation of the excretion from the roots, of which much account was formerly taken by Marcet and DeCandolle.

Since the above was written we have learned with sorrow the death of *Professor Henfrey.* In the announcement, the editor of the Gardener's Chronicle appropriately remarks, that "Professor Henfrey has long been known as an excellent histologist and sound vegetable physiologist. Especially conversant with the botanical literature of the Germans, it has been to his pen that we owe many valuable dissertations upon subjects little attended to in England. The papers in the Micrographic Dictionary of his friend, Dr. Griffith, are justly celebrated for their accuracy as well as skillful condensation. The physiological part of his Elementary Course of Botany, and the papers on Vegetable Structure now in course of publication in the Journal of the Royal Agricultural Society will always be regarded as the productions of one who was not only familiar with the truths of science, but able to render them attractive to those who are little accustomed to think upon such subjects." Probably his best original contribution to science was his investigation into the formation of the embryo in *Santalum.* A. G.

6. *Some plants take arsenic with impunity.*—That vegetables are killed by watering with an aqueous solution of arsenic was long ago shown by Marcet, Jäger, Link, &c., and also by experiments made in this vicinity within the present year. Still, moulds will grow in paste poisoned with arsenic, and some insects will feed upon animal matter impregnated with arsenic without apparent injury.* Notwithstanding these known exceptional cases, however, the following statements, condensed from the Gardener's Chronicle for Sept. 10, are startling, not only in a physiological point of view, but because, if confirmed, they must affect all medico-legal evidence in cases of suspected poisoning. Dr. Edmund Davy, Professor of Agriculture and Agricultural Chemistry in the Royal Dublin Society, knowing that sulphuric acid containing arsenic was largely employed in making superphosphate and other artificial manures, and that these must therefore contain variable quantities of that substance, conceived it probable that plants supplied with such manures might imbibe some arsenic, and in this way be rendered more or less unwholesome as articles of food. To ascertain, in the first instance, whether plants really take up arsenic when presented to their roots in the soil, Dr. Davy transplanted into a flower-pot three small plants of peas, and when they were established, he commenced watering them every second or third day with a saturated aqueous solution of arsenious acid; and *this treatment was continued for more than a week without its appearing to produce any injurious effects upon the plants.* At this period Dr. Davy was obliged to leave home for some months; on his return he found that these plants had grown up to their full size, had flowered and fruited. On chemical examination he detected arsenic in them, both in the herbage and the seeds. Having thus learned "that arsenic might be taken up in considerable quantity by plants without destroying their vitality, or appearing even to interfere with their proper functions," Dr. Davy proceeded to ascertain whether arsenic as it existed in different artificial manures (such as the superphosphate) would in like manner be taken up by plants growing where these manures had been applied. He tried the experiments with cabbage-plants in a soil consisting of one part of superphosphate to four of garden mould. When a plant had *grown healthily in this soil for three*

* See this vol., p. 166.

weeks (where, the wonder is, that it should have grown at all, irrespective of the arsenic), he cut off its top, tested it for arsenic, and found "the most distinct indications of the presence of that substance." Finally, to ascertain if arsenic could be detected in crops grown with superphosphate in the ordinary way and amount, he took turnips from fields in which this manure had been used, and obtained from them "the most unmistakeable evidence of having been arseniated." The facts thus collected appear to Dr. Davy "to have some important bearings; for though the quantity of arsenic which occurs in such manures is not large when compared with their other constituents, and the proportion of that substance which is thus added to the soil must be small, still plants may during their growth, as in the case of alkaline and earthy salts, take up a considerable quantity of this substance, though its proportion in the soil may be very small. Further, as arsenic is well known to be an accumulative poison, by the continued use of vegetables containing even a minute proportion of arsenic, that substance may collect in the system till its amount may exercise an injurious effect on the health of men and animals." Dr. Davy's paper is published in the London, Dublin, and Edinburgh Philosophical Magazine, Aug. 1859, p. 108. A. G.

7. *Death of Mr. Nuttall.*—We learn that this veteran naturalist,—whose health has for several years been much impaired,—died on the 10th of September last, at his residence, Nutgrove, near Preston in Lancashire, at the age of seventy-three. In view of the great services which Mr. Nuttall has rendered to the botany, ornithology, and mineralogy of the United States during the last forty years, a fitting tribute to his memory may be expected from the hands of some of his surviving friends.

The death of *Dr. Horsefield* is also announced, at the age of 86 years. While Mr. Nuttall, born in England, passed the active portion of his life in the United States, Dr. Horsfield, born in Pennsylvania, made his scientific collections in Java, under the East India Company, in whose service, at the India House, he continued down nearly to the close of his long and honorable life. A. G.

ZOOLOGICAL NOTICES.—

8. *Bidrag till Spitsbergens Molluskfauna: jemte en allman öfversigt af Artiska Regionens, naturförhallanden och forntida utbredning*, af OTTO TORELL. Part I, 8vo, pp. 154 and 2 plates. Stockholm, 1859.—A work of much interest to naturalists and others who have directed their researches to the Arctic regions. The first part commences with a historical and geographical account of Spitzbergen, with geological notices, chiefly of glacial phenomena, and a comparison of the fauna of the island with that of neighboring countries for the advancement of our knowledge of geographical distribution. A table is given showing the distribution of 160 species of birds around the Arctic circle. But in this table he makes many species common to the two continents which are not so in reality, as has been recently determined by Baird and Cassin. In the systematic account of the Spitzbergen mollusca this Part reaches only to *Arca* among the bivalves. The synonymy is well elaborated, and the errors of Middendorff and others in that of the *Crenellæ* are exposed.

The following instances will show the opinion of the author with regard to the synonymy of species also found on the New England coast. *Modiola nexa*, Gould, is *Crenella nigra*. *Mytilus levigatus* (*discrepans*,

Gould) is *C. substriata* (Gr.). *Nucula tenuis* of Gould is *N. expansa* Reeve, and not the *tenuis* of Europe. *Leda tenuisulcata* of Stimpson is *L. pernula*. *Leda sapotilla* is *L. hyperborea* Lovén (?) One new genus is described, *Dacrydium*, for a shell which is supposed to be the *Modiola vitrea* of Möller. It differs from it in its "dentes crenulati, antico tuberculiformi, postico elongato, cristis suffulti decurrentibus," etc. The occurrence of an *Arca* (*A. glacialis*) in so high a latitude is noteworthy.

W. S.

9. *Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn for Aaret* 1858. With 2 plates. Copenhagen, 1859.—This number contains the following articles:—Plantæ Centroamericanæ; *A. S. Oersted*. Ad Bryologiam Norvegicam annotationes aliquot; *Th. Jensen*. Some remarks on the northern species of the genus *Aega*, and on the proper limits of the genus; *C. Lütken*. On Stegophilus insidiosus, a new fish from Brazil, and on its habits; *J. Reinhardt*. Description of a new species of Serolis, S. Schythei; *C. Lütken*. Annulata Oerstediana, etc.: Enumeration of the Annelides collected by Oersted and Kroyer in the West Indies and Central America; *E. Grube*. Description of the "Gallernosen" at Lolland; *Kostrup*. Supplement to my conspectus of the Danish Echinodermata and to my catalogue of the West Indian and Central American serpent-stars; *C. Lütken*. Winter-flora of Nice; *C. Vaupell*. On the dwelling of the true *Cymothoa* in the mouths of various fishes; *C. Lütken*. Proceedings of the scientific meetings of the Natural History Society in the year 1858. W. S.

10. *Bidrag till Kännedomen om Skandinaviens Amphipoda Gammaridea af* R. M. Bruzelius. (Kong. Vet. Akad. Handl. 1858,) pp. 104 and 4 plates.—A most valuable contribution to our knowledge of that difficult order the Amphipoda. 77 species are described, of which 18 are new. The new genera are *Lætruatophilus* (fam. Dulichidæ), *Autonoe* (fam. Corophidæ), *Eriopis* (fam. Gammaridæ), *Paramphithoe*, for *Amph. panopla*, *hystrix*, *bicuspis*, etc., (why reject *Amphithonotus* Costa,) and *Nicippe*, near *Pardalisca*. Nineteen species are figured. The descriptions in Swedish are very elaborate, and a Latin character is given for each species. W. S.

III. ASTRONOMY.

1. *Supposed planet between Mercury and the Sun.*—At a session of the French Academy of Sciences, Sept. 12, 1859, a paper by M. LeVerrier was read, giving the result of his researches undertaken in order to ascertain the cause of the discrepancies between the places of Mercury as determined by observation of its transits across the sun and as required by theory. He finds that by adding 38 seconds to the secular motion of the perihelion of Mercury, these observations will be represented within about one second. The cause of this disturbance he presumes to be either one planet or a group of small planets within the orbit of Mercury; and calls on observers to watch the sun's disc in order to detect the transit and also during total solar eclipses to scrutinize the vicinity of the sun.

Note.—In this connection it may be worth while to state that there are already on record observations which make it highly probable that there exists an intra-Mercurial planet with a satellite. Wartmann reports

(*Bibl. Univ.* Avr. 1837, p. 409; *Quetelet: Corr. Math. et Phys.*, Aug. 1837, p. 141) that Pastorff, of Buchholz, an attentive observer of the solar spots, saw twice in 1836 and once in 1837 two round black spots of unequal size, moving across the sun, changing their place rapidly, and pursuing each time routes somewhat different. He found that the two bodies observed Oct. 18, 1836, traversed an arc of 12′ from $2^h\ 20^m$ to $3^h\ 12^m$; that the two observed Nov. 1, from $2^h\ 46^m$ to $3^h\ 42^m$ traversed in this time an arc of 6′, and that the two observed Feb. 16, 1837, traversed an arc of 14′, between $3^h\ 40^m$ and $4^h\ 10^m$. In 1834 Pastorff saw two similar bodies pass six times across the disc of the sun. (*Bib. Univ.*, t. 58.) The larger was about 3″ in diameter and the smaller 1″ or 1″·25. Both appeared perfectly round: sometimes the smaller preceded the larger, sometimes the contrary. The greatest observed distance between them was 1′ 16″. The bodies were often very near each other and their transit then occupied only a few hours. They had the appearance of a dull black spot, like that of Mercury in its transits.

On further search the following statements were found, which may perhaps bear on the case. Flaugergues mentions (*De Zach: Corresp. Astron.*, vol. 13, p. 17, 1825) that Pastorff saw *two* remarkable spots on the sun Oct. 23, 1822, and also spots July 24 and 25, 1823. Olbers (in *Tilloch's Phil. Mag.*, vol. 57, p. 444, 1821) cites Gruithuisen's observations of three solar spots June 26, 1819, viz., one near the middle of the sun, and *two small ones without nebulosity* near the western limb.

M. LeVerrier's new Tables seemed, (by the Report made to the French Academy, Aug. 4, 1845, C. R. 21: 316,) to show that Mercury suffered no unexplained disturbance. Nevertheless, in the hope of finding this presumed planet I undertook in the year 1847, in conjunction with Mr. Francis Bradley, to observe the sun's disk twice a day when practicable, and also to explore the neighborhood of the sun with a telescope armed in front with a long pasteboard tube blackened inside. These efforts, made with an instrument badly mounted, in an inconvenient place, proved fruitless, and were finally given up on account of the pressure of other work. Such observations ought to be resumed by those who can command suitable means. The fact that for twenty years past no such bodies as those seen by Pastorff have been detected by the numerous observers of solar spots may perhaps be due to the large inclination of the planet's orbit. E. C. HERRICK.

2. *Shooting Stars of August* 9–10, 1859.—The following observations by Prof. A. C. Twining at Boston, Mass., and by Mr. Francis Bradley and others at Chicago, Ill., show that the usual meteoric display of August 9–10 occurred this year, but on a scale somewhat reduced. E. C. H.

(1.) *Observations at Boston, Mass., by Prof. Twining.*—"From $2^h\ 15^m$ A. M. to $3^h\ 30^m$ (10th) I observed 45 conformable and 11 unconformable meteors in a space around the radiant whose radius would be about the arc from the Pole to *α Tauri*. The sky clear; paths of meteors not long nor brilliant; two left visible traces for about six seconds. The average place of the radiant during the time of observation was near 38° 30′ A. R. and 57° 15′ N. decl."

(2.) *Observations at Chicago, Ill., by Mr. Francis Bradley and others.*—July 29, 1859, 10½ to 11½ P. M.—watching alone, looking chiefly to the northeast, Mr. B. observed in the hour *sixteen* shooting stars, of which

five or six only were conformable to the August point of radiation. Aug. 5, 11 to 12 P. M.—*nineteen* shooting stars were observed during the hour, seven or eight of which were conformable.

Aug. 9. Observers—Messrs. F. Bradley, Wm. Dickinson, E. P. Marsh, and after 1 of the 10th, Mr. L. Baird. The sky was nearly clear, and the moon interfered until about one o'clock.

Shooting stars observed:

11 to 12 P. M.,	in N.	12	
" "	" W.	7	
" "	" E.	6	25
12 to 1 A. M., (10th,)	" N.	12	
" "	" W.	13	
" "	" E.	14	39
1 to 3 A. M.	" N.	54	
" "	" E.	33	
" "	" S.	61	
" "	" W.	78	226
3 to 3½ P. M.,	" N.	24	
" "	" E.	10	
" "	" S.	22	
" "	" W.	22	78

The meteors were plainly increasing in frequency during the latter part of the time. Few of them were large, and only a small number of all were unconformable to the point of apparent radiation usual at this date.

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Earthquakes in California during* 1858; by J. B. TRASK, M.D.—During the past year we have had occasion to note the occurrence of eight shocks of earthquake in this State. This number is one half less than that in 1857, and one third less the number in 1856. The shocks with one exception have been unmarked by anything like violence, being little else than mere vibrations or tremors unnoticeable by the great majority of the people. They are as follows:

Feb. 10th.—A smart shock at Kanaka Flat, Sierra Co. No time noted.

Feb. 15th.—A light shock in San Francisco at 4^h 20^m. Was observed in the county of San Mateo ten miles south of the city.

Aug. 19th.—A light shock in San Francisco at 22^h 10^m. The motion was east and west and undulatory.

Sept. 2nd.—A smart shock at Santa Barbara, no time given.

Sept. 3rd.—A smart shock in San Jose at 0^h 40^m. This shock was felt at Santa Cruz 25 miles west, and was evidently more marked in strength at that locality. No damage.

Sept. 12th.—A smart shock at San Francisco at 19^h 40^m. The motion was from north to south. There were two vibrations with undulatory movements lasting about fifteen seconds.

Sept. 26th.—A light shock at San Francisco at 1^h 26^m.

Nov. 26th.—A heavy shock at San Francisco at 0^h 34^m. This shock was by far the heaviest during the year, it awoke most people from slumber and created no little alarm, persons left their beds and sought cooler

situations with less attire than is usually worn. The iron pillars in the second story of the custom house have separated from the ceiling above about half an inch, and are supposed to have settled from the effects of the shock: I much doubt the alleged cause of this displacement, as the pillars below present no indications of similar disturbance. This shock was felt at Oakland ten miles east of the city, but was not felt at Stockton, Sacramento, or Marysville. It was evidently confined to an area of ten or twelve miles.

Up to this date, (Aug. 10th, 1859,) there have been but three shocks during the present year.

2. *Eruption of Mount Hood.* (Extract from a private letter dated San Francisco, Sept. 4th, 1859).—"On the 15th, 16th and 17th of August, 1859, the atmosphere at this place (Portland, Oregon,) began to grow quite sultry, on the 17th the air very soon after ten o'clock became exceedingly hot, a very unusual circumstance here. The sky up to noon was nearly cloudless, but after meridian the heavens assumed an unusual aspect; on directing our attention toward Mt. Hood we all observed a most singular collection of clouds hovering over the summit, having a light silvery aspect, mingled with others of darker hue, heavy and apparently lowering. Up to the close of the following day nothing else unusual had occurred, the clouds still hanging over the mountain. On the evening of the 18th flashes of light were frequent from about the summit, and a full volume of illuminated vapor at times would ascend. On the 19th and 20th heavy volumes of cloudy vapor continually poured out from the crater, and on the evenings of these days the shafts of flame were almost constant, the light was continuous through the night. On the 20th the smoke cleared up for a short time affording a view of the summit, it was observed to have changed its aspect to the naked eye, but with glasses the upper northwest side of the summit had disappeared entirely, it had the appearance of an immense gap, the presumption is that it has fallen in. There are parties on their way to the mountain to explore it, and on their return I will write you again."

3. *Improved mode of preparing Diatomaceæ;* by Christopher Johnston, M.D. (In a letter to the editors dated Baltimore, Md., Sept. 14th, 1859.)—Allow me to offer an improvement in the preparation of guano, diatomaceous earth, &c., for mounting either dry or in balsam. It consists in the substitution of chlorate of soda for the chlorate of potash employed according to Bailey's method; and the whole process may be thus summed up. 1. (Say for guano) wash in water. 2. Boil in nitric acid. 3. Pour off the acid from the sediment, add fresh acid, boil for fifteen minutes, pour in a little muriatic acid and boil for five minutes. 4. After complete washing out of the acids, carbonize the residue with strong sulphuric acid; effect the combustion of the carbonized portion with *chlorate of soda;* wash perfectly with water, and the diatoms need no further treatment.

Two things are gained by this method; 1st. Sulphate of soda is very soluble and may easily be removed by washing—this is not the case with sulphate of potash. 2d. It renders unnecessary a new boiling in acid of the residual sand, diatoms, &c., as recently proposed by a distinguished practical microscopist of this country for the perfect removal or destruction of sulphate of potash remaining *in* or about the diatoms. Protracted

boiling in strong acids injure the valves of diatoms, and especially those which have delicate markings; Bailey's method as modified by your subscriber subjects them to the least possible risk of being broken or defaced.

4. *Proposition for a Humboldt Fund for Scientific Investigations and Travels.*—[We have received from the venerable and distinguished Carl Ritter,* the illustrious Geographer of Berlin, the following "Proposition," and take pleasure in laying it before the American public in the hope that the appeal which it impliedly contains for American contributions may not be in vain. We shall be very happy to receive and transmit to Berlin any contributions to the HUMBOLDT FUND which the friends of science may entrust to us.—EDS.]

"In the course of centuries there springs up here and there a man who, uniting powers of investigation and generalization, like Aristotle or Leibnitz, represents in himself the multifarious science of his time. Among these few powerful minds belongs ALEXANDER VON HUMBOLDT; bold and cautious, profound and comprehensive, alike fertile and brilliant, a pride and a joy to his contemporaries of both hemispheres. What he brought to life in science will never die, but will continue bearing fruit by its own inherent power. But his place in the world is left vacant, and that prompt and helpful love, that unwearied and fostering zeal which the struggling scientific talent of every land found in him are departed. No one can render aid productive of such results as that rendered to science by Alexander von Humboldt. Nevertheless it is a natural wish to perpetuate beyond his life through an Institution, this noble department of his activity.

"It is therefore proposed to found an institution under the name of the *Humboldt-Stiftung*, having for its object to afford assistance to rising talent, wherever it may be found, in those directions to which Humboldt devoted his scientific energies, viz., scientific labors, and extensive journeys of exploration.

"It is proposed to confide the distribution of any means obtained for this purpose to the scientific body of which he has been a faithful and efficient member for sixty years, and which only a few weeks before his death listened to his animating voice, viz., the Royal Acad. of Sciences at Berlin.

"This body upon the proposal being made, has declared itself ready to draft and in conjunction with the Committee to establish the statutes of the Association, adapted to the amount of capital subscribed, and to apply its resources worthily in assisting promising or already developed talent. In pursuing such an aim we recognize the hindrances which arise from the circumstances of this particular period. But we do not shrink in these excited days of war from quietly carrying forward the everlasting mission of peace entrusted to science, which binds all nations in one.

"It is due to the memory of Alexander von Humboldt, and it seems to us no impracticable thought, to unite in one efficient body the Princes who honored him, the members of that Nobility to which he by birth belonged, the scientific litterateurs who admired him, learned men who were enchained by his cosmopolitan spirit, the circle of trade who profited by his discoveries, the prominent persons in cultivated European circles where he worked, as well as in other lands of both worlds—to unite them all so as to form a living monument to his name, which shall work on for science from age to age.

* Whose demise we have to lament since writing these lines.—See p. 461.

"In this feeling we take the liberty of inviting a collection for the Humboldt-Stiftung, and beg that subscriptions may be sent to the banking house of Mendelsshon & Co., in Berlin. The collected capital will be invested with prudence and the interest applied to the specified objects. In six months a report will be rendered to the public.

"We recommend then in full confidence to the active friendship of all who recognize in truth and gratitude the greatness of the departed, an institution which will work down to remote ages in Humboldt's spirit, and do honor to his name."

[This memorial is signed by F. v. Bunsen, Ehrenberg, Dove, Encke, Lepsius, Magnus, Ritter, and sixteen others.]

5. *The 29th Meeting of the British Association for the Advancement of Science* was held at Aberdeen, Scotland, commencing on the 14th of September.—It was graced by the presence and the hospitality of Royalty. The Prince Consort made a very sensible opening speech, and the meeting appears to have been in all respects a good one.

6. PROF. J. D. DANA sailed for Europe in October, for an absence of about a year. Rest from his too severe and long continued scientific labors which had begun to tell upon his health, was the leading motive of his journey. He spends the winter in southern Italy.

7. PROF. AGASSIZ returned in September from his late visit to Switzerland refreshed in health and spirits, and laden with treasures for the new museum at Cambridge, the building for which we learn is rapidly approaching completion.

8. *Government Scientific Expedition in New Mexico.*—In our notice of Dr. NEWBERRY's *New Mexican Explorations* on page 298 of this volume, we inadvertently neglected to say that Dr. Newberry is connected with a government expedition under the War Department, commanded by Capt. McComb of the U. S. Army, under whose direction the investigations are being made.

9. *Journal of the American Oriental Society.* Vol. vi, No. 1.—This Society, in its zealous cultivation of oriental literature, has just now been placing the scientific world under special obligations. Two important papers, revealing to the English reader some of the treasures of Oriental science, occupy nearly the entire number of the Journal now before us, the annual half volume for the current year.

The first is an article of 128 pages by the Chevalier N. Khanikoff, Russian Consul-General at Tabriz, Persia. It consists of an analysis and extracts of an Arabic work on the water-balance, written by 'al-Khâzinî in the twelfth century, and entitled *Book of the Balance of Wisdom.* This paper, originally in French, the Committee of Publication have here presented in English, with a translation *de novo* of the extended extracts from the original work, which are here printed in Arabic, in connection with the portions of the article to which they belong. The committee have also appended a large body of critical and explanatory notes.

The Balance of Wisdom or Water-Balance, is a balance for determining specific gravities; and the Arabic work here analyzed and translated is a systematic treatise on the subject, containing descriptions in detail, with figures of several ingenious forms of such balances; also expositions of the philosophical and mechanical principles involved in their construction and use, together with experimental results. It is a curious and very instructive monument of the state of experimental philosophy among the Arabs, at a time when they became almost the sole custodians of the

science of the world; the treasures which they had obtained by conquest from Greece and India being faithfully kept by them during the long eclipse of European learning until the western nations, emerging from the darkness, were ready to receive them at their hands, and under the influence of a higher civilization develop the germs thus providentially preserved into the rich fruits of modern science.

We quote a few specimens of the results for specific gravities given in the "Book of the Balance of Wisdom," in connection with modern determinations.

Substances.	acc. to 'al-Khâzinî.	Modern authorities.
Gold,	19·05	19·26–19·3
Mercury,	13·56	13·56–13·59
Lead,	11·32	11·35–11·44
Silver,	10·30	10·43–10·47
Copper,	8·66	8·67– 8·85
Brass,	8·57	8·40– 8·60
Iron,	7·74	7·6 – 7·79
Tin,	7·32	7·29
Emerald,	2·75	2·68– 2·77
Pearl,	2·60	2·61– 2·75
Salt,	2·19	2·07– 2·17
Wax,	0·95	0·96
Boiling Water,	0·958	0·960
Ice,	0·965	0·916–0·927
Sea Water,	1·041	1·029–1·04
Olive oil,	0·920	0·918–0·919
Human blood,	1·033	1·053

The other article referred to, filling 128 pages, is the first part of a translation from the Sanskrit of one of the oldest and most important text-books of Hindu astronomy, the Sûrya-Siddhânta, with notes and an appendix, by Rev. Ebenezer Burgess, formerly missionary of the A. B. C. F. M. in India, assisted by the Committee of Publication.

We only call attention to this very interesting paper at the present time, as it will deserve a more extended notice when completed. The original work is composed, like most of the Sanskrit literature, in metrical stanzas of two lines each, and its concise and peculiar forms of statement would to a great extent, be unintelligible even when translated, without the full and scholarly commentary which has been supplied by the several editors. This commentary, which is largely indebted for its value to the sound oriental scholarship of Prof. Whitney, and to the mathematical supervision of Prof. Newton, of Yale College, is adapted to the wants of two distinct classes of readers,—those who are orientalists without being astronomers, and those who are astronomers without being orientalists; thus rendering this important exposition of Oriental Astronomy attractive to all those who would learn more distinctly how much the world is indebted to the Hindu mind for so many of the elements of scientific, as well as of general, knowledge.

10. Obituary.—Prof. Carl Ritter the distinguished Geographer, died at Berlin, Sept. 28th, in his 81st year. He was born August 8th, 1779.

Death of Dr. Grailich.—We are pained to record the early death of Dr. Joseph Grailich the distinguished crystallographer and physicist. At the time of his decease Dr. Grailich was Professor of mathematical physics in the Imperial University at Vienna and one of the Adjunct Curators of the Imperial Mineral Cabinet. He died at Vienna on the 13th of September in the 31st year of his age.

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